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Development of the Upper Cuyahoga River, Cleveland, Ohio.

BY C. M. BELDING, RIVER AND HARBOR ENGINEER OF THE CITY OF CLEVELAND.

In years past, the harbor of Cleveland has consisted of two distinct parts, the outer harbor which has been improved by and is under the control of the United States government, and which is formed by two breakwaters enclosing and protecting an area nearly 2 miles long and 1,700 ft. wide, containing about 375 acres. (See Bulletin No. 18 of Northern & Northwestern Lakes.) The inner harbor consisted of Cuyahoga river and Old River bed and connecting slips and is maintained by and is under control of the city of Cleveland.

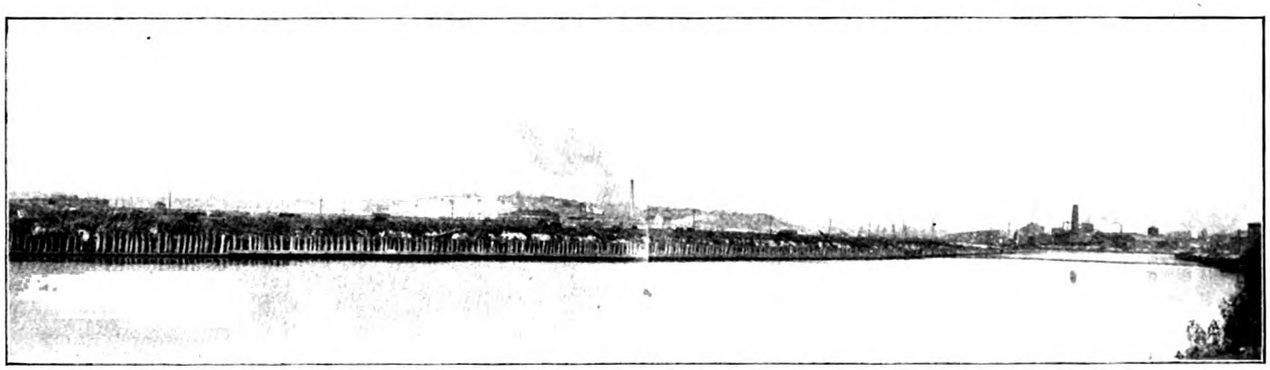
On account of the growth of our industries along the river front during the last 10 years, it has been an absolute necessity to increase the river frontage by pushing southward a distance of about a mile and by widening, straightening and dredging so improve the channel as to open up to commercial purposes a vast acreage which is now known as the Upper Cuyahoga river.

This article will describe the development of the upper river. The history of the legislation is as follows: In 1876 the council passed a dock line ordinance, fixing the dock lines from upper Seneca street (near what is now the Sherwin-Williams elevator) to the south line of Aiken farm near the river lock of the Ohio canal.

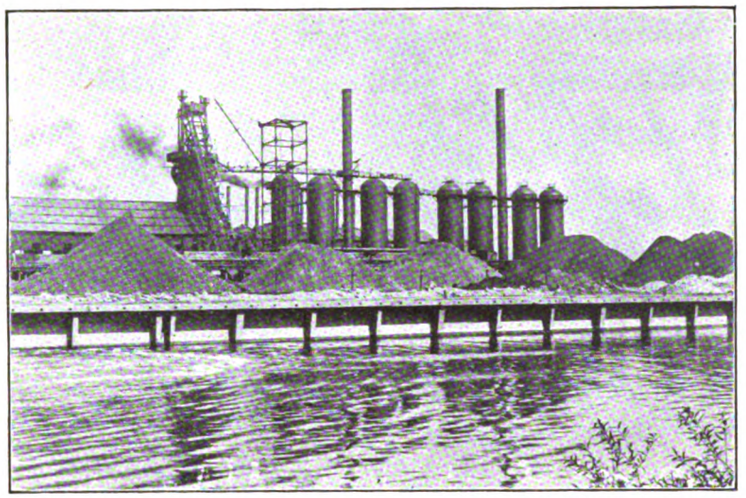
At that time there was little traffic in this new section, it being principally confined to lumber, and such merchandise as came through the canal, which was in a flourishing condition. The principal concerns located on this part of Cuyahoga river were the Cleveland Rolling Mill Co., Standard Oil Co., and what is now the Grasselli Chemical Co. When it was first planned to dredge this new section the channel was so full of logs that one dredge put in an entire summer on logging alone and the depth of water was not enough to float a canal boat. Dredging was carried on to the Weigh lock to be filled in by spring freshets the following year. Such were conditions up to about 15 years ago.

One menace to all concerns located upon this section of Cuyahoga river were the floods that came every few years. Usually the ice jams would form at Jefferson street bridge and before they could be broken up the water would overflow the entire upper section, extending from the foot of Dille street to Riverside cemetery.

Jefferson street channel was V shaped, with the bridge at the bottom of the V and here always was the



SHOWING NEW FRONTAGE OF CORRIGAN, MCKINNEY & CO.



CLEVELAND FURNACE CO.'S DOCK AND PLANT.

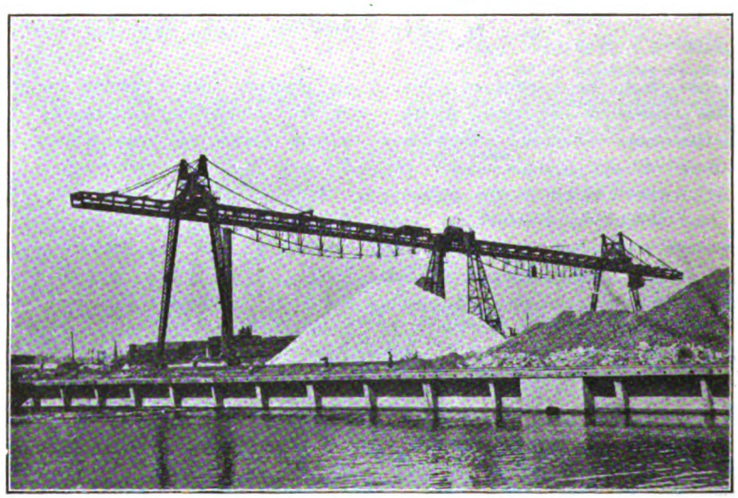
point of trouble. Lumber yards could not locate in this district as it was not an uncommon sight to see whole piles of lumber being washed away during this flood period.

About the year 1895, a general awakening as to the value of river frontage as related to industrial growth began to manifest itself and the chamber of commerce and Mayor McKisson acted in harmony with the result that an honorary river and harbor commission was appointed consisting of Hon. Theodore E. Burton, Hon. T. E. Holden, Hon. Clifton B. Beach, W. C. Richardson and Robert Bandlow. The chamber of commerce commitee was headed by Harvey D. Goulder.

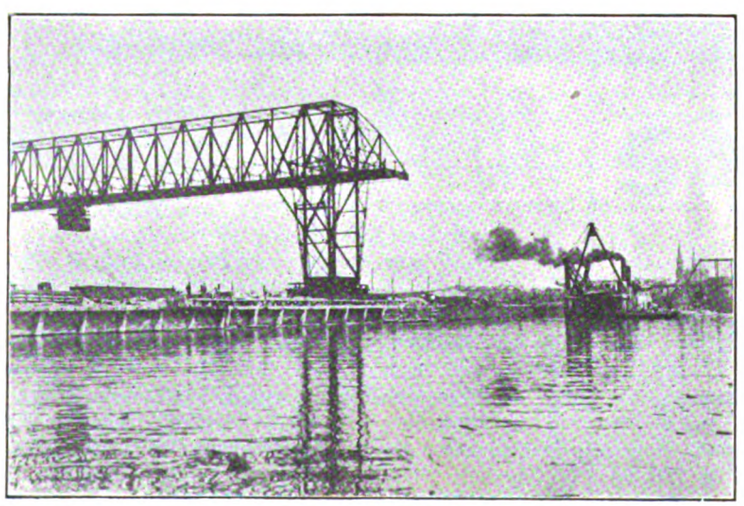
Results began to show themselves immediately and the widening began in earnest from the Lake Shore bridge to the Superior viaduct. One of the projects to be pushed forward was the straightening of the channel at Jefferson street. It was seen that by so doing all flood damage could be averted and the increase in ore received at the Central furnaces was demonstrating that river frontage even four or five miles up the river was desirable.

Land was purchased, docks built across the new cut and a new bridge planned, and finally the dredging completed, so that in September, 1907, navigation opened through the new cut.

In 1904 another dock line ordinance was passed extending the limits still further up the river to a point 1,400 ft. south of the Upper Wheeling & Lake Erie railroad bridge and almost to the Cleveland paper mill.



BROWN CONVEYOR.



HOOVER & MASON CONVEYING BRIDGE.

The river above the Jefferson street cut is at no place less than 200 ft. wide and a winding basin has been provided where boats up to 600 ft. can be turned around after discharging their cargoes, and come down stream bow first instead of stern first as formerly which was hazardous and also costly.

Land was purchased and bulkheads built by both city and private owners and the dredging of this new section started in September, 1905. On account of the low nature of the land adjacent to the docks it was feasible to deposit the dredged material upon the low land by hydraulic dredge, which was a great advantage to the property owner in having his marshy land filled up, and to the city in saving at least $70,000, the differ-

ence between the cost of hydraulic dredging and that of towing it to the lake in scows.

Under this contract 700,000 cu. yds. were taken out of the new river channel and deposited on the adjacent lowlands. (For detailed description see MARINE REVIEW of Dec. 14, 1905.) The material was principally sand and gravel, which finds its way into the river bed from the surrounding hills at time of freshets.

Two years before this work was started the Cleveland Furnace Co. located upon the west side of Cuyahoga river above the Wheeling & Lake Erie railroad bridge, having a frontage of about 6,000 ft.

This site has for railroads the B. & O., Wheeling & Lake Erie, Cleveland Belt & Terminal, and the Newburg & South Shore, the latter one being then a short line between the Central blast furnaces of the American Steel and Wire Co. and its steel mills at Newburg. This same railroad now connects with the new Belt line and also the Erie railroad at Newburg, giving it a fine advantage for handling freight from these lines. A 400-ton furnace was erected and the first iron made in August, 1903, two years before our river dredging was started, which ultimately was to reach their plant. At that time a large Brown 10-ton conveyor was erected to handle their ore and limestone which was received at the Wheeling & Lake Erie docks opposite the Central blast furnaces and carried out on cars and dumped into stock piles. (See photgraph.)

This conveyor will be used for ore handling next year when the ore is to be unloaded from boats in front of their new dock.

Being in operation only five years this company has nearly completed an additional furnace which will double its capacity and has also added a 15-ton Hoover & Mason conveyor which will place them in a position to handle rapidly and economically all ore and limestone that comes to their dock. (See photo of Hoover & Mason conveyor.)

Their dock is of concrete, 1,000 ft. in length and was described in the MARINE REVIEW of April 11, 1907.

In the photograph is seen a general view of their furnace and dock, four of the eight stoves being for use with their new furnace which is in process of erection. Last week the first load of limestone was unloaded from boat to dock and this event marks the beginning of activity for the upper river.

Directly above Jefferson street to keep pace with the progress of a wider and deeper river channel, the Newburg & South Shore Railroad Co. erected a Scherzer rolling lift bridge, double track and leaving a 120-ft. clearance for vessels. Following their example the B. & O. railroad constructed a duplicate of this bridge about 200 ft. up stream.

A vast area on the west side of the river and extending from the B. & O. railroad bridge to the upper Wheeling & Lake Erie railroad bridge was filled up with dredged material in 1905 and 1906. On account of being divided by the Wheeling & Lake Erie railroad right of way which cut across it in such a way as to render the land not practical for docks, it not being deep enough, this drawback seemed to hamper the sale for commercial purposes until four months ago.

The Corrigan-McKinney Co. have now purchased all of this land bounded by the river and the Newburg & South Shore railroad and extending from the B. & O. railroad bridge, a distance of about 2,900 ft. along the Cuyahoga river, it being from 300 to 1,000 ft. in width and containing about 40 acres. Their plan is to move the railroad tracks to a position parallel to the Newburg & South Shore railroad, thus giving them ample space for their two 400-ton furnaces. The photograph gives an idea of their frontage on Cuyahoga river.

Having ample room for docks, storage yards and furnaces, and having the same railroad facilities as the Cleveland Furnace Co. gives the Corrigan-McKinney Co., a point of vantage for the manufacture of iron that is not equaled by any concern in Cleveland. Their site is only two miles from the Public Square by way of Third street (old Seneca) it being the same distance from the Public Square as E. 40th street (Case avenue). The future is indeed bright for the new upper river section.

The Clark avenue grade crossing with the B. & O. railroad is nearly completed which will, when the plan is followed out connect each side of the river.

On the west side of this new river section above the B. & O. bridge, the Grasselli Chemical Co.'s plant extends to the Weigh lock.

The Ohio canal frontage occupies nearly all of the balance and at present the state is protecting its banks by having a pile and timber bulkhead constructed for a distance of about 1,000 ft.

On this easterly side of the river the available land is greater even than on the westerly side, but is isolated by the canal which completely blocks all use of the river frontage. The plan that should now be started and pushed to completion consists of moving the Weigh lock and river lock to a point near the paper mills, abandoning the canal below this point. This would add a very valuable acreage of river frontage for manufacturing sites. We need it and must have it opened up because the present conditions are hindering Cleveland's growth.

A few words in closing as to the cost of these new improvements, shown in the following table:

Land at Jefferson street	$ 29,500
Docks	18,788
Dredging	26,000
New bridge	200,000
Bulkhead built by city, etc.	19,000
Land for widening	16,000
Hydraulic dredging	124,000
Additional dredging	60,000
State bulkhead	30,000
Total public expense	$523,288
Private bulkhead	$ 75,000
Dock at Cleveland furnace	35,000
Railroad bridges (B. & O., N. & S. S.)	250,000
	$360,000
Grand total	$883,288

In conclusion it might be well to discuss the needs of this new section.

First, the canal should be abandoned to a point near the Cleveland Paper Co.'s plant. Result, land used for commercial purposes, meaning increased tax value, more revenue, and thus more dredging could be done.

Second. New Wheeling & Lake Erie railroad bridge. Present one is of old center pier type and is a hindrance to navigation.

Third. A settling basin or dam built across Morgan river valley to catch the sand that comes down in times of high water. This would decrease by half the amount that has to be dredged.

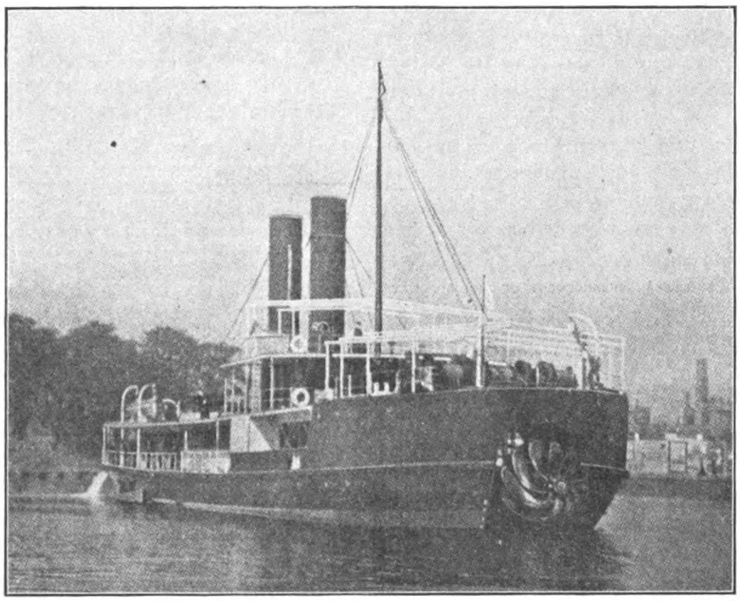
Fourth. An increased amount of money each year for dredging.

The city spent in 1908, $60,000 for dredging. This is about $12,000 per mile of river or about $1 per ft. front. The increased valuation in the land in the upper river alone will bring in enough in taxes to allow us to spend at least $100,000 each and every year.

If we had that amount annually it would be possible to have a 20-ft. channel the entire length of the river, ready by April 1 each year, and to maintain it until the close of navigation.

RECLAMATION DREDGES FOR BOMBAY.

There was launched from the works of William Simons and Co., Limited, Renfrew, on 13th inst., the first of two large suction pump and discharging dredges which that firm are building for the Bombay Trust. The vessel, which is named the Jinga, has been specially designed and constructed for the Sewri Reclamation scheme at Bombay, and is fitted with what is claimed to be the most powerful pumping plant afloat. It has been designed to dredge 2,700 tons of material per hour, and



RECLAMATION DREDGE FOR BOMBAY.

to discharge the spoil through a floating pipe line fitted with steel ball-and-socket joints, and land pipes to a distance of upwards of 4,500 ft. from the side of the dredger. The sister ship to the Jinga is in a forward condition in the builders' works, and both dredgers will be employed on the extensive reclamation scheme at Bombay referred to. It is estimated that by the operations of these two dredgers, under the present scheme alone, an addition of 4½ per cent will be made to the area of the city of Bombay.

The pumping plant of each dredger consists of very large centrifugal suction and discharging pumps, directly coupled to triple-expansion surface-condensing engines. A large condenser is fitted to take the exhaust steam from all engines on board. The Jinga is arranged to proceed to Bombay under her own steam, and for this purpose two sets of compound surface-condensing engines are provided, capable of giving the dredger a speed of eight knots. Steam is supplied from four very large cylindrical multitubular boilers, constructed to Lloyds full requirements and fitted with Howden's patented forced draft The boilers are specially designed for burning inferior Indian coal. A very full equipment of engine-room auxiliaries is provided, including independent circulation pumps, automatic feed pumps, bilge and general service pumps, feed heater, filter, evaporator, etc.

A spiral rotary cutter is fitted at the lower end of the suction frame, this cutter being driven through steel spur gearing by a set of compound surface-condensing engines. The suction frame is controlled by independent steam hoisting gear. Bow and stern winches of very powerful construction, arranged for rapid handling, are provided. The control of the dredger is centered on the operating bridge, on which are placed all telegraphs, speaking tubes and signals for controlling the cutter engines, pump engines and stern winch, as well as the handles for controlling the frame hoisting gear and the bow winch. One man can thus direct all the operations of the dredger and the pipe line. The living accommodation and the general arrangements are all designed for a vessel working in a tropical climate, every attention having been given to light and ventilation. The boat is electrically lighted throughout, having a powerful searchlight for manipulating the dredger's pipe line when working at night. Telephone communication between the dredger and the end of the pipe line is also provided.

The Jinga, as launched, was complete and ready for her trials, the naming ceremony being performed by Mrs. A. J. Barry. Both dredgers have been constructed under the direction of Sir J. Wolfe Barry and A. J. Barry, MM. Inst. C. E., consulting engineers to the Bombay Port Trust, and of George Turner, resident inspecting engineer.

TRIAL OF DESTROYER PARA.

The official trial of the destroyer Para, built for the Brazilian government by Messrs. Yarrow & Co., Ltd., Glasgow (late of Poplar, London), took place recently in the Firth of the Clyde, when a speed of 27¼ knots was obtained during a continuous run of three hours, carrying a load of 100 tons. The Brazilian government was represented by His Excellency Admiral Duarte Huet de Bacellar, chief of the Brazilian naval commission, Captain Almeida and Lieut. Godofredo da Silva, representing the construction department; Captain Bartholomeo da Silva, chief of the engineering department, and Captains Perry and Frontin, who will command the first two vessels.

SCHERZER BRIDGES.

The Scherzer Rolling Lift Bridge Co., Monadnock block, Chicago, has just issued a revised and enlarged edition of its catalog upon the Scherzer rolling lift bridge. The catalog is practically a history of the Scherzer lift bridge and is embellished with hundreds of photographs of this type of bridge in all parts of the world, including a beautiful colored plate of the Scherzer bridge across the Neva river adjoining the winter palace at St. Petersburg. This type of bridge is too well known to require extended mention. Its advantages are many and it has undergone steady development during the past 15 years, being now adapted to meet the varying conditions of traffic as well as beauty of architectural design. For waterways in which space is at a premium, it is incomparable.

The White Star Steamship Co. has decided to name its two large new liners destined for the Atlantic service Olympic and Titanic. The keel blocks of the Olympic have already been laid down at Belfast, while work on the Titanic will be begun early in 1909.

YUMURI'S CREW SAVED.

A story of shipwreck which surpasses the most thrilling of any conceived by Clarke Russell was brought to New York a few days ago by the crew of the Norwegian steamship Yumuri, which went to pieces beneath the feet of her sailors off Castle Island, one of the Bahama group, in the recent hurricane. The men, after terrible sufferings, were rescued by a volunteer crew from the Prins Willem I of the Royal Dutch mail line. The rescue party, in charge of Chief Officer Wagemaker of the Prins Willem, rowed through a boiling surf in a broken boat and brought all the shipwrecked men off in safety from the barren shore upon which the Yumuri had stranded. One of the Prins Willem's party jumped overboard from the lifeboat at the risk of his life in an unsuccessful attempt to save the Yumuri's papers, which the captain of that vessel accidentally dropped over the side.

On the arrival of the Prins Willem I at this port one of the rescued sailors was sent to the Marine hospital on Staten Island, where he will probably die as a result of his awful experience. The skipper of the Yumuri is still suffering from the pounding he suffered in being washed ashore over the rocks. Many of the sailors have been under the doctor's care since they were rescued.

The rescued officers of the Yumuri are Capt. A. Engebretsen, First Officer Harold Olsen, Second Officer Marjus Jacobsen, Chief Engineer Carl Evensen, and Second Engineer Sigobald Dahl.

The weather was fair when the Yumuri left Port Antonio on Sept. 10, bound for Baltimore with a cargo of fruit. The next morning, when she passed Cape Maisie, Cuba, there was an easterly wind blowing, and the falling of the glass showed that bad weather was coming on. With the shifting of the wind to the north later in the day the wind freshened to a gale. Then came the hurricane. At noon on Sept. 11 the ship was 85 miles east of Castle Island, and by that time it was blowing so hard the crew had to batten down the hatches and cover them with tarpaulins. Rain and squalls made it necessary to run at half speed, and the steam whistle was kept blowing all the time because of a heavy mist which set in with the rain.

"The wind at midnight turned west, and we were unable to steer the ship with any exactness," said Capt. Engebretsen in telling of the wreck. "We ran at half speed astern for two hours, as I was afraid we would be driven on to the rocks west of Castle Island.

"The seas constantly came on board, and, despite the steam pumps, which were kept steadily at work, the hold became filled with water. I kept the crew bailing the water out with buckets all night. There was no sleep for any one, and conditions kept growing worse every minute until the vessel was in such a state that there was danger of her sinking.

"But the first day and night of the storm were as nothing compared to Saturday, Sept. 12. The wind increased every minute, and at 9 o'clock Saturday morning the seas became so high that they practically engulfed the steamer. The fires were put out by the seas, and this stopped the engines, so we were completely at the mercy of the hurricane.

"It was blowing and raining so hard, and the waves were running so high that it was impossible to stay on deck. All we could do was to lock ourselves beneath the hatches and pray for succor. Thus, helpless and crippled, we drifted away in a northwesterly direction, driven by the hurricane. About 2 o'clock on the afternoon of Sept. 12 the steamship struck the rocks."

The crew felt the steamship strike twice on the rocky bottom. It was death to stay where they were. The port lifeboat had been smashed, and so the skipper called all hands on deck and told them to put on lifepreservers. By this time the vessel had been carried inshore and was pounding on the rocks with every sea that broke over her. In desperation the men worked on their way down the deck and made an attempt to lower a lifeboat on the starboard side. It touched the water, smashed against the steamer's side, and droppel into the boiling surf, a mass of kindling wood.

The ship's company retreated to the fo'cas'le, which was nearest in shore and less exposed to the fury of the hurricane. There they stayed all night, fearing every minute would be their last. The hull shifted and pounded with every blow of the seas that broke over her. The superstructure was carried away, and finally the vessel broke amidships. The men, clinging to whatever offered a handhold, waited for daylight. In an occasional lull in the rain they cou'd see the flash of the lighthouse on Castle Island. Thus they waited all night, exhausted from their fight with the storm, bruised, and without food or drink. Little by little the hull broke up, until the men had little more than the bow of the ship to rest on. With morning the captain decided that their support would not hold together much longer, so he bade them all jump and try and reach the shore.

"There is no use trying to describe what followed," said one of the men. "We got through somehow."

The first men ashore had to go back again to pull out their comrades. The captain was unconscious and bleeding from four jagged cuts where his head had come in contact with the sharp rocks when they pulled him ashore. The chief officer was almost as bad when they got him out, and two of the men would have been drowned unless helped to land.

The condition of the men when they landed was pitiful. Capt. Engebretsen was suffering terribly from his injuries. The hurricane was still blowing, and the men were two miles from the lighthouse, the only habitation on the island.

The men started for the lighthouse through a marsh, and it took them hours to cover the distance. They had to carry the first officer at times, and the skipper had to be assisted more than once.

One of the men carried a bag of oranges, part of the cargo, that had been cast up; another carried an oilskin bag in which the captain had put such of the ship's papers as he could get together. When they got to the lighthouse the keeper did everything he could for them. There was no place for them to stay except in the lighthouse, and that was open at the top. The rain poured in, and it was much like living at the bottom of a well. The keeper gave them meat and drink.

"I spent the night in misery," continued the captain. "My head bothered me. Tired as we were, there was no chance to sleep, and the chief officer became very ill from exposure."

On Tuesday morning the Prins Willem I, from St. Marc, passing Castle Island, saw the distress signals flying from the lighthouse. Capt. A. R. Nybeer ran in, and soon made out the signals, which were in the international code: "Ship in distress. Send boat to take off crew." he read.

The weather was then fair, but a very heavy surf was running. Chief

Officer Wagemaker volunteered to take a boat ashore, and a picked crew was selected to aid him. They got away from the steamship in safety, but Wagemaker, misjudging the power of the surf, tried to drive his boat directly through it to the shore. A wave caught the craft and sent it spinning ashore. It landed far up on the sand with a hole driven in its bottom. The officer and men picked themselves up and, with the help of the wercked crew, the hole was patched with canvas and the boat was carried out beyond the surf. The Prins Willem men scrambled in and with them went six of the men from the Yumuri. All the way back to the steamer the men had to bail to keep afloat.

The Prins Willem had a rough voyage before she arrived off Castle Island, having been driven into the bay at St. Marie, Haiti, by the storm. This delayed the steamer, and it was due to this that she passed Castle Island after the Yumuri's men were cast up there.

Capt. Engebretsen has been 15 years in the fruit trade between Jamaica and the United States, as mate and master of the Yumuri. The Yumuri was built at Middlesborough 18 years ago and was owned in Bergen, Norway. She was a small steamer of 473 tons and carried fruit for the United Fruit Co. Capt. Engebretsen and his crew had hardly enough clothes to cover them when they were rescued. The crew of the Dutch steamer supplied them with temporary outfits.

Castle Island is at the south end of Ackland Island in the Bahamas. It is about one mile long and three miles wide and is uninhabited save for the light keeper and his family.

Under the direction of the board of inspection of the navy, with Rear Admiral Thomas C. McLean as president, the submarines Cuttlefish, Tarantula and Viper were given a 24-hours' submergence test Sept. 17. The test took place in Narragansett Bay and the waters of Long Island sound.

The New York Maritime Exchange is bending its efforts toward having the cruise of the Atlantic battleship fleet brought to a culmination at New York. It is expected that the fleet will reach the Atlantic coast in the latter part of February, 1909. It has been conjectured that the cruise would end at Norfolk, but it is now believed that the efforts of the New Yorkers will not be without results.

THE USE OF SEA WATER IN MARINE BOILERS.*

BY JAMES SHIRRA.

The use of sea water for feeding marine boilers, while not so common as it once was, experience having taught us its dangers and inconveniences, is not altogether unknown, especially as a "make-up" or supplementary feed, while donkey boilers or those used for working cargo in port are too often fed with it; so a knowledge of the risks run and precautions to be observed is still all important to marine engineers. The literature of the subject, however, is often confusing and contradictory; the old rules of practice which suited the low-pressure boilers fed from jet condensers are abrogated, and none have been laid down authoritatively to take their place.

With the triple expansion engines and high pressures, the engineer's endeavor should be to keep the boiler water density always below that of sea water, making up losses by the evaporator, or by pure soft water when in port. A light scale, such as may be got by filling the boiler at first with sea water, is all right if it adheres to the right places, but it will often adhere to the tube necks only, leaving the other heating surface black and pitted by the chlorides introduced. Better to keep all corrosive agents out of the boiler by using only pure and hot feed, and there will be little need of a protective scale. Perkin's water tube boiler, tried over 30 years ago, which was fed from a surface condenser worked with "plenum," not vacuum, the pressure on the steam side being always higher than on the water side, the feed always over 212° Fahr., and no leaks of sea water or air into it possible, should have been an object lesson to engineers sooner than it was; the boiler when cut up (the only way of inspecting it) had practically no corrosion in it after years of use.

The salinometer for the modern engineer ought to be a chemical one, to indicate not ounces of salt, but grains of chlorine per gallon. The test is simple, and the corrosion from free chlorine more hurtful than any other. The amount of salt is strictly proportional to the amount of chlorine, but we should never get it by the ounce or pound, in main boilers anyway.

Donkey boilers, however, sometimes have to be fed with sea water, and often are when better arrangements could be made. The saltness in them should never be allowed to exceed 4 —"32" s. A heavy coat of scale will form by such feeding whatever density is kept, but a slight neglect on the donkeyman's part to "blow" at the proper time might easily produce "salting" if a higher density is carried, and should never be risked. In a recent case, where the furnace of a donkey boiler collapsed through a thick crust of salt forming on it, the engineer had used the drain cock of the gage glass, mounted on a long stand pipe, instead of the proper salinometer cock; the water from this was bound to be fresher than the boiler water owing to condensation of steam in the top end of it, and a thorough blow through of the pipe could hardly be counted on—but even thus the salinometer showed, or was estimated to show, 25 oz., and as this is mentioned as a safe density in our "handbooks," he continued feeding his boiler at sea water until saturation, salting and collapse occurred. Then he found that his gage class was showing false water owing to its contents being much lighter than the saturated brine in the boiler, and sought to put the blame on the donkeyman for allowing the water to get too low, though there was no sign of the combustion chamber top having ever been uncovered. We find engineers of "tramp" steamers also using their main boilers without auxiliary condensers to work cargo in port, and feeding them with sea water, getting their tubes leaky at the back ends thereby; their superintendent engineer at their home port would not sanction the expenditure of 1s 6d per 1,000 gallons fresh water from the wharf they lie at being their excuse. The merchant shipping act does not know anything about superintending engineers, and a chief engineer has no more right to blame his superintendent for a wrong procedure on his own part than to blame his subordinates.

The use of sea water is chiefly condemned because of the dangerous incrustation it forms, of which, so far as the lime of salts are concerned, the salinometer gives no indication, though it gives warning of an approach to salting; and it is also much more corrosive than pure water. There is an objection to its use, however, often quoted, which is purely fanciful. Since its boiling temperature is a little higher than that of fresh water we are told that it takes more fuel to evaporate it. But, as engineers, we are really more concerned with quantity of heat than with intensity, with thermal units than with temperatures

*From a paper read before the Institute of Marine Engineers.

and the specific heat of sea water being only 0.934 of that of pure water, it actually takes less heat to raise a pound of sea water to its boiling point than one of fresh under the same conditions. The amount of steam formed thereafter depends only on the heat units absorbed by the water, and the slightly higher temperature of the salt water effects this quite inappreciably.

The waste of heat through having a crust of scale on the water side of the heating surfaces is also not so great as we are often told. There is a quite considerable loss of heat and fuel so caused, but the engineer who believes the "boiler-fluid" agent who promises to save half the coal bill if some nostrum for removing scale is adopted will be woefully disappointed. The real danger of scale is of overheating, straining and weakening the metal, but the hotter metal has more "thermo-motive force" to overcome the resistance to the heat current into the water, and sends heat units into it at not so much less a rate than when clean.

It has been noticed that furnace collapses occur even when boilers are worked nearly fresh, perhaps more frequently than when salter water is used; but this is due to the soft deposit of magnesia and carbonate of lime combined with oil adhering to the furnace. Some hard fresh waters contain much more of these salts than sea water does, and they get entangled in the oily scum on the water surface generally found with condensing engines. As long as this floats it does no harm, but getting heavier by degrees than fresh water, it will sink through it and adhere to the heating surfaces, especially when under banked fires and the water "off the boil," producing a very dangerous coating. If the water is salt and dense, this scum does not so readily sink, but remains a scum and the furnaces escape the danger. The true remedy for this is not to use salt water, but to filter the feed and avoid the use of "hard" water.

The thirty-seventh annual meeting of the National Board of Steam Navigation will be held at the Hotel Majestic, Philadelphia, Pa., Oct. 7 and 8. This is Founders' Week in the Quaker City and an elaborate program has been prepared in which the members and guests of the National Board of Steam Navigation will no doubt find much enjoyment. The association looks for a banner attendance.

IMPORTANCE OF RIDEAU CANAL.

Consul H. D. Van Sant in a recent report states that while the commercial importance of the Rideau canal and lakes, leading from Kingston, Ontario, to Ottawa, has largely diminished, its future possibilities of usefulness as a water highway should be noted, particularly as it keeps open a considerable field for the sale of American manufactures and products. The consul's description of the canals follows:

"The canal for a distance of 126¼ miles is dotted with small villages and towns visited by large numbers of American fishermen and tourists in the summer and affording for eight months in the year a readily reached market for American coal and kerosene, farming implements, miners' tools and machinery, fishermen's supplies, canned goods, wagons and carriages, wire fencing, hardware, windmills, cheap cotton goods and fabrics, and other staple articles sold to the country trade.

"The total income of the canal during the fiscal period of nine months beginning March 31, 1907, was $4,957. In freight 82,159 tons were carried, an increase of 22,295 tons, of which 31,430 tons were the product of the forest and 9,990 tons were coal. The passenger receipts are made up largely from Americans who visit the lakes and canals for sight-seeing and fishing and whose numbers seem to be yearly increasing.

"The Rideau canal was commenced in 1823 and completed in about seven years. Before this date engineers sent from England had reported the proposed canal impracticable, but afterwards the project was taken in charge by engineers of the British army stationed in Canada, and to the sapper and miners' corps, aided by the regular soldiers of the British army, belong the credit of final construction.

"The canal has cost the Imperial and Canadian governments $4,085,889, and a conservative estimate places the present cost of such a system of locks, dams and canal at from $20,000,000 to $25,000,000, exclusive of the cost of operation. The repairs to the canal in 1907 amounted to $55,634.

"The canal has 35 ascending and 14 descending locks and 39 dams or abutments. One of them, at Jones Falls, is 90 ft. in height and includes three sets of locks, while the one at Kingston Mills, near Kingston, is 60 ft. high. The total lockage makes up 282¼ rise and 164 fall at high water. The locks are 134 by 33 ft. with a depth in water of 5 ft. The canal breadth at bottom reaches 60 ft. in earth and 54 ft. in rock, while the breadth of canal at surface of water is 80 ft. in earth and rock. The strength of the canal is shown in the fact that there has been no serious breakage in any of the larger locks or dams since its construction.

"Before the Lachine and Cornwall canals were built the Rideau was the important commercial waterway between Montreal and Lake Ontario ports by way of the Ottawa river, and its traffic was large and profitable. It was the only route then opened for navigation with the lakes trade from Montreal that avoided the ascent of the Lachine and other rapids in the St. Lawrence river. Now a railroad connects Ottawa City with Brockville on the St. Lawrence, a shorter route, yet there still remain the markets along the Rideau, easier and cheaper to reach by water than by rail, and in the case of barges saving transshipments and winding, not only through Kingston, Smith Falls and the Ottawa, but through the Perth canal and inland through the adjacent country."

Norton & Son, New York, have announced a new Brazil steamship service in which the steamship Newton Hall is to sail from pier 2, Bush Terminals, Brooklyn, on Oct. 5, with freight and passengers direct to Santos, thus inaugurating the possibility of a new rate-cutting war in this trade. Some months ago the situation settled down after a long period of demoralization, following an agreement between the Lamport & Holt, Prince and Hamburg-American lines, through which a joint service was established, leaving the Lloyd Brazileiro as the only disturbing element until the advent of the new Norton venture.

The Panama Railroad Co.'s steamer Colon came into port at Colon, Panama, on Sept. 18, after having been badly battered by the hurricane which she had encountered at noon the previous day. One of her smokestacks was carried away, three boats washed overboard and the wireless telegraph apparatus dismantled. The sea washed over the vessel to such an extent that the mail bags were soaked. Three of the crew were suffocated in the hold in an attempt to safeguard the fresh water supply.

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THE WEST AND THE MERCHANT MARINE.

It seems incomprehensible at first glance that the American people, as keen and shrewd as any in the world and second to none in patriotism, should have allowed their merchant marine to shrink to such a feeble skeleton that the United States navy cannot move its battleship fleet across the Pacific ocean without the help of foreign collier "tramps," and that the United States mails for the most important countries of South America have to be sent out via Europe.

As a people we have shown in other things no lack of virility or foresight. We have, under protection, developed the greatest manufacturing industry in the world. We have built a strong navy and an efficient and complete system of seacoast defenses. Our policy in these regards has been characterized by a notable spirit of resolution, self reliance and independence. Why is it that there has been such a melancholy contrast in our treatment of the question of the merchant marine?

The answer is not far to seek. The long refusal of Congress to protect and encourage the merchant marine, as all other things have been protected and encouraged, is due to the narrow and fortunately waning opposition of a relatively small group of public men in the far inland states of this country. Ours is a continental republic. It is a long range from sea to sea. Perhaps it is not surprising that some of the people of the inland states should not understand the importance of possessing a merchant shipping of our own, and that they should retain in Congress public men who habitually vote against legislation in which shipping is concerned. It must be remembered that for a long time many of the representatives in Congress from the Middle West opposed the upbuilding of the navy.

The latest alignment of the national house on this question of ocean shipping is instructive. This most recent test was had on May 23, 1908, when the Ocean Mail Bill was offered as an amendment to the Post Office Appropriation bill. All but two of the democratic representatives voted against it. That is not strange, for the Democracy, the minority party, is naturally the party of opposition. But there voted with the Democrats no fewer than 36 Republican representatives. All but one of these 36 came from interior states. Their action resulted in the defeat of the ocean mail amendment by the close division of 145 to 153. In other words, a change of five votes would have given the ocean mail legislation a majority.

Now let us see just whence these men hail who defeated the earnest recommendation of President Roosevelt for adequate mail pay to American steamship lines to South America and across the Pacific ocean. Only one of them was from Ohio. This was the Hon. Theodore E. Burton, of Cleveland, whose attitude disappointed all and angered many of his constituents. The state of Ohio desires unitedly and earnestly the upbuilding of the American merchant marine, and Mr. Burton in this vote did not represent the wishes or the interests of his people.

All of the Michigan representatives recorded voted for the bill. So did all but two of the Republican representatives from Indiana, a majority of those from Illinois, and three out of five of those from Nebraska. Summing up, 88 middle western Republicans voted for the Ocean Mail bill and 35 against it, a majority in the middle western country for this measure of more than two to one.

So it cannot be said that the Middle West as a whole is opposed to the development of our merchant shipping. The question, doubtless, is not so well understood in Wisconsin or Kansas as it is in Ohio, but it is sufficiently understood in most of the middle western states to justify their representatives in Congress for voting for the American ship and disregarding the specious pleas of the foreign steamship corporations. That the foreign steamship agents have long been very active in the Middle West to arouse hostility to American merchant shipping is perfectly well understood. As Senator Gallinger, former chairman of the Merchant Marine Commission, said recently in Washington:

> Western misunderstanding of the ocean mail legislation, wherever it exists, I am convinced, is due in large part to the propaganda maintained for many years by the rich and powerful European steamship combinations through their emigrant agencies scattered all over the western country. These foreign ship companies are afraid of a vigorous, competing American merchant marine. They now monopolize nine tenths of our ocean carrying, and receive for this more than $200,000,000 a year. Because there are no American ships, these foreign concerns are able to force the United States government to pay double transit rates for the privilege of sending our mails to South America via Europe, and they are scheming now to drive our flag off the trade routes in the Pacific ocean.
>
> It is these alien monopolists who have the assurance to assail the Ocean Mail bill as in the interest of "monopoly"—though the bill has no more earnest champions than President Roosevelt and Secretary Taft. This is a measure in the interests of the safety and independence of America and

the freedom of the seas. As before suggested, I am confident that before the Sixtieth Congress adjourns the Ocean Mail bill will have won sufficient new support in the Middle West to insure its final passage by a strong majority in the house of representatives.

The Merchant Marine League of the United States, from its headquarters in Cleveland, has in its campaign of education done much to offset this adroit European steamship propaganda. The result is manifest in the steady increase of middle western support for shipping bills in Congress. A year and a half ago an ocean mail bill, not so broad in its scope as the more recent measure, was opposed in the national house by 56 Republican representatives, or 22 per cent of the entire Republican strength. Last May only 36 Republicans, or 16 per cent, were opposed. At the next trial it is certain that very few middle western votes will be cast against the ocean mail legislation, and that the project is, therefore, apparently destined to win. Moreover, it may very safely be assumed that when the vigorous and patriotic people of the Middle West once come to a thorough understanding of this merchant shipping question, they will be as resolute and as enthusiastic in sustaining a broad policy toward our merchant marine as they have been for 20 years in sustaining the increase of the American navy.

This forecast of the situation is confirmed in rather a striking way by advices which we happen to know have lately been sent to European steamship interests by an agent especially engaged to make inquiry as to the prospects of ocean mail legislation at the next session of Congress. This agent, after a survey of the situation, has reported to his European principals that nothing was more certain than that there had come a change of temper in the Middle West, and that the Gallinger Ocean Mail bill would be enacted by a favorable vote of the national house at the session of Congress opening in December.

The crew of the steamer Neshoto, which was lost on Lake Superior, were taken to Cleveland on the steamer H. S. Sill of the Gilchrist fleet.

LAKE FREIGHT SITUATION.

Ore shipments for September were 4,646,024 tons, a decrease of 1,571,629 tons for September, 1907. The movement to Oct. 1 of the present year has been 16,630,960 tons as against 30,559,206 tons in 1907, a decrease of 13,928,246 tons. To bring the total movement to 25,000,000 tons this year the fleet will have to move about 8,500,000 during the balance of the season. This figure will probably represent the maximum movement of the year, which will therefore be 17,000,000 tons less than the movement of 1907.

There is practically no change in the coal and ore trades, contract vessels covering the movement easily. The grain trade has shown a decided improvement and there is a lively demand for small carriers in this trade.

Following are the ore shipments by ports:

Port.	Sept., 1906.	Sept., 1907.	Sept., 1908.
Escanaba	833,681	742,251	654,679
Marquette	411,582	417,684	245,708
Ashland	384,968	407,572	483,959
Superior	869,678	1,155,464	541,235
Duluth 1,750,116		2,203,638	1,617,134
Two Harbors....1,179,636		1,291,044	1,103,307
	5,429,660	6,217,653	4,646,024
	To Oct. 1, 1906.	To Oct. 1, 1907.	To Oct. 1, 1908.
Escanaba	4,270,294	4,473,417	2,006,192
Marquette ...	2,120,519	2,342,149	871,107
Ashland	2,636,025	2,722,331	1,521,146
Superior	4,448,174	5,571,918	2,264,443
Duluth	8,334,388	9,406,283	6,201,121
Two Harbors.	6,341,357	6,043,108	3,766,951
	28,150,755	30,559,206	16,630,960

PIG IRON SITUATION.

Dullness prevails in the iron market, and certain it is that the prediction that the market would be artificially stimulated for political effect has not been fulfilled. Some substantial advances, especially in the Chicago district have been made, however, where specifications on the books of the leading interest increased 30 per cent in September over August, and orders 25 per cent. Recent car orders have resulted in a fair tonnage of orders being placed for steel under frames, plates, shapes, etc. The general report respecting pig iron is one of inactivity, but prices are generally firm. The total production of pig iron for September was 1,416,252 tons, an increase of 50,233 tons over August. There is a somewhat better demand for forgings, billets and bar products. The drouth in the Connellsville, Pa., region has been responsible for at least one plant of 500 ovens shutting down, and other operations are in danger. This, rather than increased demand, has made prices firmer.

ENTRANCE TO DULUTH HARBOR.

Capt. W. G. Rogers of the steamer Monroe C. Smith, called at the office of the MARINE REVIEW this week and as an aid to navigation offered a suggestion that has much merit and one which is herewith submitted to the consideration of the Lake Carriers' Association. Some time ago Capt. Rogers was endeavoring to make the harbor of Duluth in dense smoke and fog. He was unable to pick up the pier lights, though he could hear the whistle distinctly. He proceeded with great caution, endeavoring to pick up his position by sound. Finally he took the glasses to see if he could locate the pier lights. They were not discernible, but what was discernible, however, was the span of the aerial bridge across the ship canal. It occurred to Capt. Rogers that if a cluster of lights were placed in the direct center of this span that it would mark the harbor entrance distinctly and would be visible when the pier lights were not visible. The span is 160 ft. above water and is ordinarily above the region of fog. In fact, the town lights on the hills of Duluth are frequently visible when all other lights are obscured by fog. Changes have recently been made in the character of the pier lights at Duluth, but it occurs to the REVIEW that it would be well to adopt Capt. Rogers' suggestion and put a cluster in the direct center of the aerial bridge. The cluster could be readily arranged in such form as to make it impossible of confusion with other lights.

NEW DRY DOCK FOR BUFFALO.

The Great Lakes Dredge & Dock Co. has been awarded contract by the American Ship Building Co. for the construction of a new dry dock at its Buffalo plant. The dock will be 615 ft. long and 110 ft. wide and is to be completed by July next.

The steamer H. A. Berwind hit an obstruction while entering Conneaut harbor, and punched a hole in one of her bottom plates. The steamer Wm. E. Fitzgerald struck this same obstruction about two weeks ago. President Coulby of the Pittsburg Steamship Co. has directed the attenton of Col. John Millis, government engineer, to the obstruction, and it will be removed at once.

The Reid Wrecking Co. has completed salvage work upon the steamer Monarch of the Northern Navigation Co's. fleet, which was wrecked on Isle Royale in the fall of 1906. Nothing now remains except a few planks.

A Side Light on Detroit's Enormous Passenger Traffic.

George Uhler, supervising inspector general of the steamboat inspection service, sent out a letter to the various United States supervising inspectors of steamboats on June 9 last which clearly exemplifies how a man may encompass the very mischief which he is seeking to avoid. Undoubtedly when the board of supervising inspectors meets in Washington in January next, Gen. Uhler will be asked to rescind his ruling in this particular. Meanwhile it would be interesting to discover through whose influence he was persuaded to promulgate it. Obviously the statistics of the steamboat inspection service concerning the passenger traffic of the United States should be reliable, but under Gen. Uhler's ruling of June 9 last they are as unreliable as they possibly can be. The amusing part is that Gen. Uhler thinks he has improved their reliability. The letter in question is as follows:

"Washington, D. C., June 9, 1908.

"United States Supervising Inspectors of Steamboats:

"Gentlemen — A misunderstanding having arisen regarding the method of reporting by masters of passenger steamers the number of passengers carried, as required by Section 50, Rule 5, R. & R., and as to which board of inspectors the masters should report, you are informed that such report should be made on Form 941, to the board of local inspectors for the district from which the steamer receives the most of her business, and to such board only.

"Many duplications in the past of the reports of the number of passengers carried, have had the effect of establishing erroneous statistics, which must be positively discontinued. Local board must notify the masters of passenger steamers within their respective districts of these instructions, and local boards must not demand, nor will they be allowed to receive duplicate reports, and before recording such report they must be sure that no duplicate report has been made to any board.

"These instructions are absolutely necessary in order to secure and preserve an actual and reliable record of this feature of our business. Furnish each local board in your district with a copy of this letter.

"Respectfully,

"(Signed) GEORGE UHLER,

"Supervising Inspector General."

Section 50 of Rule 5 directs that the local inspectors shall report the passengers carried on vessels, which is well and proper, but the "nigger in the wood pile" is the sentence in General Uhler's letter that the master should report "to the board of local inspectors for the district in which the steamer receives the most of her business, and to such board only." An examination of the statistical records of the steamboat inspection service would seem to indicate conclusively that the passenger steamship lines of Detroit had much to do with the promulgation of this ruling. In a little book put out by the White Star line the following statement is made:

"Last year, as shown by the government report, no less than 7,805,558 passengers embarked on boats from Detroit alone, the city's nearest competitor on the lakes being Chicago with 1,976,944 passengers. Then comes Grand Haven, 651,347; Milwaukee, 533,715; Port Huron, 498,882; and Marquette, 457,849."

The Detroit & Cleveland line in its Magazine of the Great Lakes quotes from Curwood's articles now running in *Putnam's Monthly,* under the title, "The Romance of the Great Lakes," called so probably because it contains so few facts, the following:

"Nearly 12,000,000 passengers were carried by vessels of the eighth district, which begins at Detroit and ends at Chicago, while less than 4,000,000 were carried in the ninth district, including all lake ports east of the Detroit river. Astonishing as it may seem, 8,000,000 passengers were reported at Detroit last year, or as many as were reported at all lake cities combined, including great cities like Buffalo, Cleveland and Chicago."

Now these figures are perfectly absurd, and their incorporation into the statistics of the steamboat inspection service is no credit to the astuteness of that body. General Uhler has apparently been played upon by the insatiable ambition of Detroit to be regarded as the premier passenger port on the lakes. Attention was first called to this maneuver last summer when masters of steamers having a terminus in Detroit refrained from reporting to the local board of inspectors at Toledo, Buffalo, Cleveland and other contributary cities. When the local inspectors got after them the masters of the vessels informed them that they had been directed to report all passengers at Detroit, and when the local inspectors appealed to the supervising inspector they were met with the letter quoted above from Gen. Uhler. An examination of the statistics of the local inspectors' offices at various Lake Erie ports now shows that the White Star line carried no passengers from Toledo, the Detroit & Cleveland line none from Cleveland or Toledo, and the Detroit & Buffalo line none from Buffalo. Such Clevelanders as spent the summer on Mackinac Island did not actually leave Cleveland—they left Detroit. Two excursions that were run on Detroit & Cleveland steamers from Cleveland to Put-in-Bay are not credited to Cleveland but to Detroit. All the ferry business between Detroit and Windsor is credited to Detroit—none left Windsor. It might be pertinent to inquire whether the Michigan Central and Grand Trunk passengers that are ferried across the river on railway cars are included in these water-borne statistics of Detroit. It is the little joker in Uhler's letter, "to the board of local inspectors for the district from which the steamer receives most of her business, and to such board only," that turns the trick. Thus by a simple process of arithmetic General Uhler achieves his desire to avoid duplications and Detroit satisfies its ambition to be the leading passenger port of the lakes.

Now, as a matter of fact, if the order is to be taken literally, the Detroit & Cleveland line should report all of its passengers to Cleveland, because its steamers receive the most of their business at Cleveland. The embarkations from Cleveland to Detroit are greater than the embarkations from Detroit to Cleveland. As an evidence of this, the company's new steamer City of Cleveland was invariably chartered to leave Cleveland on Saturday night, when the greatest crowds are usually traveling. In fact, the bona fide passenger business of Cleveland is greater than that of Detroit, Detroit's enormous trade being practically a ferry service.

Inquiry at the Cleveland and Buffalo offices elicits the information that its Cleveland embarkations are reported to the local inspector at Cleveland and its Buffalo embarkations to the local inspector at Buffalo. This is as it should be, and all duplications, which Gen. Uhler so greatly fears, are thereby avoided. The Detroit lines should follow a similar practice. It is a small matter, of course, but govern-

ment statistics should be reliable. If they are not reliable, they are worthless.

PILOT RULES FOR THE GREAT LAKES.

Editor MARINE REVIEW:—In the issue of May 14, 1908, of the MARINE REVIEW on pages 22 and 26, appear several severe criticisms on the pilot rules for the great lakes in general and particularly upon the danger and passing signals as laid down in the rules.

The critic is evidently a person who has never held a pilot or master's license on any steamer and therefore not, in my opinion, a competent person to instruct with regard to the rules of the road on the water, yet may criticize with the great fluency that a natural talent for criticism and book education can give, but it should be remembered that all that has been written into law and rules had its foundation in actual knowledge gained by practical experience without which experience nautical experts and writers could make no intelligent beginning or ending.

A sailor who had devoted his entire life to his calling could hardly be expected to write a very instructive treatise on farming, chemistry or mechanics. His inability to do so would appear no doubt in the first few lines of his attempt under the critical eye of an intelligent farmer, chemist or mechanic. Just as a person would betray himself in trying to write up "boyhood days" who had never had a stone bruise, whooping cough, measles or mumps.

The author of these pages of criticisms and suggestions is no doubt well posted upon scientific navigation so far as books are concerned, but how to handle a steamer under all conditions and their needs in the way of lights, whistles, and rules of the road at sea that could possibly pass for the real thing is best known and told by those who have seen years of actual service in stowing the topsail, reefing the mainsail and filling all the official positions on the forward end of a steamboat. Theoretical knowledge along these lines is not, however, at all to be despised, but it alone can never place a competent officer on the pilot house while actual service can, hence their comparative importance. Therefore, in my opinion the board of supervising inspectors with its practical knowledge is far more competent to make such rules for carrying into effect the laws of congress than any one man who has only book learning on the subject. There are thousands of obstacles and conditions that arise before the practical sailor while navigating his ship through our congested waterways that never occur to the land lubber or a person that occasionally makes a trip for pleasure or business. The suggestions with regard to passing and danger signals would probably, if put into operation, result in such confusion and complication as to be extremely dangerous. The rules for such signaling must necessarily be as few and simple as possible and not attempt an extended conversation through a code of whistles when ships are in close proximity and still approaching each other. A large majority of collisions result from not observing the rules, such as signalling too late or not at all. I believe that one or two of the rules could be amended, and one at least cut out to advantage. Yet my opinion may be in the minority in that matter and so the rule would have to stand. However, I am very confident that a closer observance of the rules as now laid down would reduce the number of collisions to a minimum, always remembering that under certain conditions a departure from the rule is permissible.

When the board meets the coming winter no doubt all apparent defects in the rules will be considered with a view to make such changes as may seem to the board conducive to safer navigation, but do not understand me that the board ever expects to amend to a degree of perfection that all will interpret the rules alike. If I had any plan by which such wording of the laws could be accomplished I would at once notify the congress of the United States and all state legislatures and the world would regret that I had not lived in the time of Moses and other contributors to the old and new testaments, that we might now be living in the glare of perfect knowledge.

Should the author of these articles referred to care to do so, I should be glad to have him call on me at my office where we might exchange a few gems of thought to our mutual advantage.

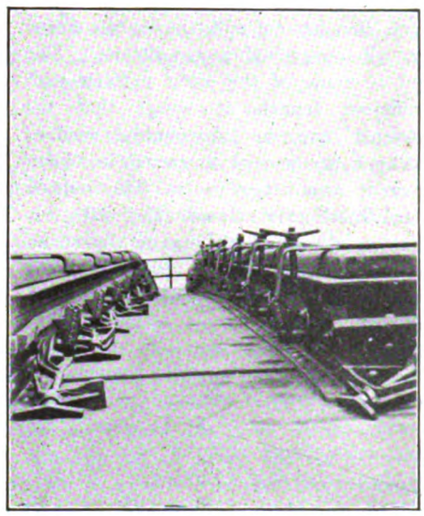
JAMES STONE,
Supervising Inspector of Steamboats.
Cleveland, Sept. 25, 1908.

Smith & McCoy, Norfolk, Va., have recently completed and placed in commission a new two-section dry dock, located on the east branch of the Elizabeth river.

THE "SECURITY" HATCH FASTENER.

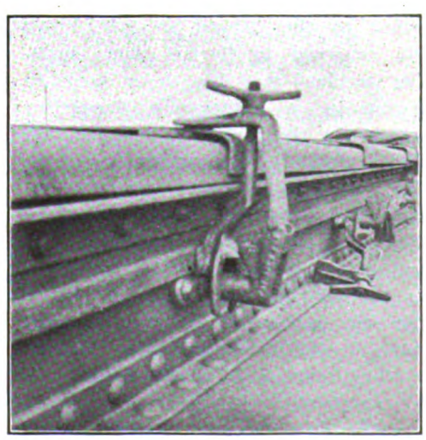
We illustrate herewith a new type of hatch fastener, the "Security," now being put upon the market by Messrs. Nacey & Hynd, of Cleveland, O., and which has already been fitted on two of the latest of the lake freighters, the James Corrigan and Daniel B. Meacham.

This new device overcomes many



"SECURITY" HATCH FASTENER.

of the defects and objections ascribed to all the different types of hatch fasteners heretofore in use. It consists of four parts; a bracket which is riveted to the hatch coaming, and has a slanting face on its inner side; a bolt which is so formed at its lower end as to engage the slanting face of the bracket and by it is pressed against the batten which secures the tarpaulin; a clamp which rests at one end upon the bracket and at the other on top of the hatch cover; the fourth



"SECURITY" HATCH FASTENER.

part being a wing nut screwed on the end of the bolt, bearing on the hatch clamp and securing all in place.

It will thus be seen that the action of the fastener in securing the tarpaulin is entirely independent of the other action of securing the hatch cover, and that notwithstanding any variation of thickness of tarpaulins under the batten or of variations or inequalities on the hatch covers the fastener can still accommodate itself at both points and will thoroughly secure the batten and the hatch cover in all conceivable conditions. The nut is made of the wing pattern with sufficient length of wings that the fastener can be thoroughly secured without the use of a wrench or hammer or any other tools. The bolt is also fitted at its lower end with extension pieces which engage the shank of the bracket and so made that the bolt cannot be disengaged from the bracket in any position so long as the batten is in place, and only then when the bolt is in an upright position, so that when the fasteners are off and thrown down upon the deck it is impossible for the parts to become disengaged, and they are always in place and ready for immediate use.

A number of prominent vessel owners and captains have lately inspected this new device and have indorsed it highly.

PACIFIC COAST NOTES.

Office of the MARINE REVIEW,
302 Pioneer Building,
Seattle, Wash., Oct. 2.

In a fog so dense that objects a few feet distant could not be distinguished, the steamer Humboldt, Capt. E. G. Baughman, bound from Seattle for southeastern Alaska ports, piled on the rocks of Mouatt Point, Pendar Island, off the Vancouver Island coast at 4 A. M. Tuesday morning, Sept. 29. The passengers were transferred to the fishing steamer Edith and returned to Seattle last night. The accident was due to an error in navigating a notoriously dangerous passage in the midst of a dense fog. The Humboldt went aground at high tide and sustained such severe damages that little hope is entertained of saving her. The entire stem and forefoot of the steamer were carried away by the collision and there is also a hole approximately 5 ft. in diameter stove in the starboard bow. If the weather remains calm and good luck is experienced the steamer may be possibly floated at an extreme high tide.

At an extreme high tide at 6:15 P. M. Sept. 30, the steamship Humboldt, which had been resting on the rocks at Mouatt Point for 40 hours, was successfully floated and has been towed to Cordova Bay, where she is transferring her cargo to the Santa Cruz in an effort to hurry it north to Dawson before the ice sets in on the Yukon. As soon as she is relieved of her freight the Humboldt will be towed to Victoria and will probably be docked at the Esquimalt. The full extent of her injuries has not yet been determined, but it is known that she is badly damaged forward.

The Toyo Kisen Kaisha, a prominent Japanese steamship company, is arranging to operate a line of steamers between Japan and Salina Cruz, Mexico, to take advantage of the connection with Atlantic and European markets by way of the Tehuantepec railway. A special report of the Toyo Kisen Kaisha was sent to Mexico. President Diaz has been interviewed and has expressed himself in favor of the new service.

The contract for the repair of the Norwegian steamer Thordis which grounded Sept. 12 off Cape Mudge has been let to the British Columbia Marine Railway Co., Esquimalt, B. C. The work includes fairing 10 plates, replacing many angle bars, and generally overhauling the hull.

Authority has been received at the navy yard, Puget Sound, for repairs to be made on the boilers and fire rooms of the cruiser St. Louis, to cost $8,000.

Improvements on the water front of Bellingham, Wash., costing $75,000 in the aggregate, will be made this winter. The Pacific American Fisheries Co. and the Puget Sound Mills & Timber Co. will spend $35,000 on dock repairs and improvements; other parties adjacent will repair their property, and L. B. Quackenbush is preparing to build a dock and warehouse to cost $15,000.

Having broken her shaft while at work in the Snohomish river, the United States snag boat Skagit has been towed to Seattle, where she is being repaired by the Moran Co.

According to statements made at a recent meeting of the finance committee of the Seattle city council the present fire boat Snoqualmie will be condemned by United States inspectors at the expiration of the present year. It is claimed that the hull is so rotten that the inspectors will not renew the license unless repairs are made. She will have to be repaired from the water line up. One hundred and thirty thousand dollars has been appropriated for a new fire boat and the contract for its construction has been let to the Moran Co. and other firms in Seattle. It is probable also that the Snoqualmie will be repaired, since the city is in need of two fire boats.

The latest rumor concerning the bitter rate war being waged between the Puget Sound Navigation Co. and the Canadian Pacific Ry. for passenger business between Seattle, Victoria and Vancouver, is that the Puget Sound Co. is acquiring the turbine steamer Atlanta from the Glasgow & Southwestern Railroad Co. to run in opposition to the C. P. R. boats. The Atlanta is a 17½-knot boat, 210 ft. long and 27 ft. beam. The rumor cannot be officially confirmed.

Engineer Clapp, of Aberdeen, Wash., in charge of the Gray's Harbor jettys, reports that the north jetty has been completed for a distance of 6,000 ft., which is the limit for this year, but that the work will be pushed another 1,000 ft. before being abandoned for the winter due to an exceptionally good season. About 30,000 additional tons of rock will be placed before winter. The total length of the jetty is to be 9,000 ft.

Schubach & Hamilton, Seattle, are to absorb the large Yukon river fleet of the North American Trading & Transportation Co., add some new steamers and with the augmented fleet compete with the Northern Navigation Co. for the traffic of the Yukon river. The lowest freight rate to Fairbanks is now $70 a ton and Mr. Schubach does not deny that his company can handle it for $40 a ton and make money. At present the tonnage going to Fairbanks is 25,000 per season and to all Yukon points double this amount.

Collector of Customs McGregor, at Astoria, Ore., has fined the Norwegian steamship Guernsey $5,000 for failing to bring a consular bill of health from Shanghai. Owing to the prevalence of contagious diseases in the Orient, including Asiatic cholera, the health regulations are being very strictly enforced on the Pacific coast, and ships arriving without a clean bill are promptly and severely fined.

ATLANTIC COAST NOTES.

Office of the MARINE REVIEW,
Room 1005, No. 90 West St.,
New York City.

As a result of the reduction in the rates of postage between the United States and Great Britain, beginning with Oct. 1, about 90,000 more letters than usual were despatched on that day by the out-going steamers Baltic, Amerika and Provence, a large proportion of this number having in all probability been saved up to take advantage of the two-cent rate. The Cunard line steamship Lusitania sailed on Saturday with 30,000 more letters than she took out on her last voyage. The American liner Merion on the same day sailed from Philadelphia with a larger volume of parcels post matter than any vessel of the American line has ever carried.

The wrecking steamer Relief arrived at New York last week with the steamship Uller, belonging to a Norwegian company, in tow. The Uller was on her course to Port Maria, where she took a cargo of bananas for Baltimore, but stopped on her northward run to take off the crew of the Yumuri, which was supposed to be still there. In going too near the shore the Uller struck on the rocks, where she remained fast. The Relief was sent to her assistance and towed the damaged vessel into deep water. The cargo had to be jettisoned.

It is reported that a direct steamship line between Scandinavia, embracing Norway, Sweden and Denmark, and the United States, will be established in the near future. The scheme has recently been perfected, after having been under consideration for some time. The idea of running independent lines from each of the three countries mentioned has been abandoned, all three contributing an equal share of the capital for the consolidated line. Six steamers will be placed in service at the commencement, the vessels sailing under the Norwegian flag and having Bergen as their home port. It is understood that the company has entered into an agreement with the German steamship companies whereby rate cutting will be avoided.

The steamship Taormina, of the Italia steamship line, ran ashore in the Delaware river when outward bound for Italy via New York. She was aground 12 hours and refloated with the assistance of four tugs. As it was dark—5:30 A. M.—when the vessel sailed, and a slight fog made the situation worse, the pilot is supposed to have missed the buoys in the narrow channel. The urgent necessity of a deeper and wider channel in the Delaware river is being strongly emphasized, and it is said that as a result of the mishap the pilots will likely in the future refuse to take vessels out at night when the weather conditions are not absolutely favorable.

The British steamship Gloriana, from Fowey to Philadelphia, while swinging at anchor off Marcus Hook on Monday, collided with the Norwegian steamship Romsdal, outward bound from Philadelphia to Cienfuegos. Both vessels were badly damaged, the Romsdal on her port quarter and the Gloriana on her port side. The accident was due to the haze surrounding the vicinity at the time.

Fire broke out last Friday in the afterhold of the steamer Rio Grande, at Mobile, it being found necessary to flood the hold to extinguish the flames. Cotton and other merchandise forming part of the 500 tons of freight in the hold were damaged, the Rio Grande sinking at the stern in 23 feet of water up to her upper deck. An exploded lamp is believed to have been the cause of the fire.

Major Horace Deakyne, United States engineer at the port of Philadelphia, has transferred the United States engineers' department of the lighthouse service, which has under its charge the construction of lighthouses and other river and bay improvements, to Captain Lewis H. Rand, U. S. A., at Wilmington, Del. Major A. F. Flagler, who formerly had charge of the work, has been transferred to Fort Leavenworth.

The proposal of Herr Ballin, director of the Hamburg-American Line, for certain of the trans-Atlantic steamship companies to adopt a common shipbuilding program by which the sum of $12,500,000 could be saved annually will, it is understood, be considered at the shipping conference to meet shortly. It is believed that the adoption of the proposal is unlikely.

Representatives of 45 foreign stations of the American Seamen's Friend Society, as well as of similar organizations of Great Britain and other countries, will meet in conference in the new Institute for Seamen, 507 West street, New York, this week, to solve some of the problems against which the sailor has to contend. The matter of supplying suitable literature to Jack ashore and afloat, steering him clear of the crimp and boarding house shark, and otherwise looking after his welfare will be some of the subjects discussed at the conference. This is the first meeting of this kind, but it is expected that hereafter regularly organized conferences will be held annually.

The United States revenue cutter Seminole reports having destroyed the wreck of the schooner Helen E. Taft, sunk about 18 miles southwest of Cape Lookout lightship. The Helen E. Taft was sunk on Jan. 29, and was before reported as destroyed. One mast of the Taft projected 20 feet from the water.

The shipments of cattle to Europe, which had practically stopped, have been resumed. The Atlantic Transport liner Mackinaw left Philadelphia recently for London, carried about 400 head of cattle, in addition to a large cargo of flour, wheat and other miscellaneous stuff.

A whistling buoy, white in color and conical in shape, is reported as being adrift somewhere in the North Atlantic. It was hard at work when last sighted. The buoy was first sighted on Sept. 28, by the steamer East Point, bound for Philadelphia, but could not be recognized.

Captain Fendt, of the German steamship Pisa, which arrived recently at Philadelphia from Hamburg, reported having used oil to break the force of the heavy seas which swept over the steamer during the continued rough weather encountered on the voyage. Capt. Fendt states that the results were most satisfactory.

Fire which broke out at sea in the coal bunkers of the German steamship Siegmund, which arrived at New York last week, for a time caused some excitement among the crew. The vessel left Santos, Brazil, on Sept. 2, with a cargo of 20,000 bags of coffee, and when two days out the fire was discovered. The damage to the cargo was slight.

While the steamer Honduras and barges were coming into Harbor Beach for shelter last week, the barge Paisley broke away and went drifting towards the beach at Port Hope. After bringing the remaining barge in, the Honduras put out again accompanied by the life savers, but the Paisley had meanwhile been picked up by the steamer Lackawanna, of the Anchor Line, and taken to Port Huron.

Mr. W. F. Look, for a number of years agent for the Chicago-Northwestern ore dock at Escanaba, has resigned.

LAKE SHIP YARD METHODS OF STEEL SHIP CONSTRUCTION.

BY ROBERT CURR.

In the issue of Aug. 13, describing Section No. 4, both E and F should be termed bilge strakes.

Aug. 20, on Section No. 5, the shell plating on side should read No. 10, G; 11, H; 12, J; 13, K; 14, L; and 16, M.

Aug. 27, on Section 6, the details C and D are reversed; it reads at the end B, D and C, instead of B, C and D.

Sept. 3, the details No. 41 should read 40, and 40 read 41.

Shows for spar deck 40 when it is described as Fig. 41.

The tank top plating is shown on sketch as 41 when it is described as Fig. 40.

The numbers and terms on Fig. 42 agree with Fig. 38 of the Sept. 3 issue and are correctly compared.

Fig. 42 is what may be termed the unavoidable weakest section or area of section of punched material.

This section governs the strength of the vessel throughout and no part should have less material than shown at the line of holes on this plan, Fig. 42.

The numbers 1, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 16, Fig. 42, represents Fig. 39.

All the interior in the tank, Fig. 42, represents Fig. 40 with the exception of bilge and side stringers.

Nos. 50, 51, 52, 53, 54, 55, 56 and 58, Fig. 42, represents the deck details, Fig. 41.

The table herewith shows the materials of Fig. 42, both punched and unpunched. The first column from left to right is the numbers corresponding to same on Fig. 42.

The second column shows the parts referred to by numbers.

The third column gives the sizes of the parts numbered.

The fourth column shows the material unpunched and area of section of same.

Column 5 shows the number of holes punched in the parts numbered.

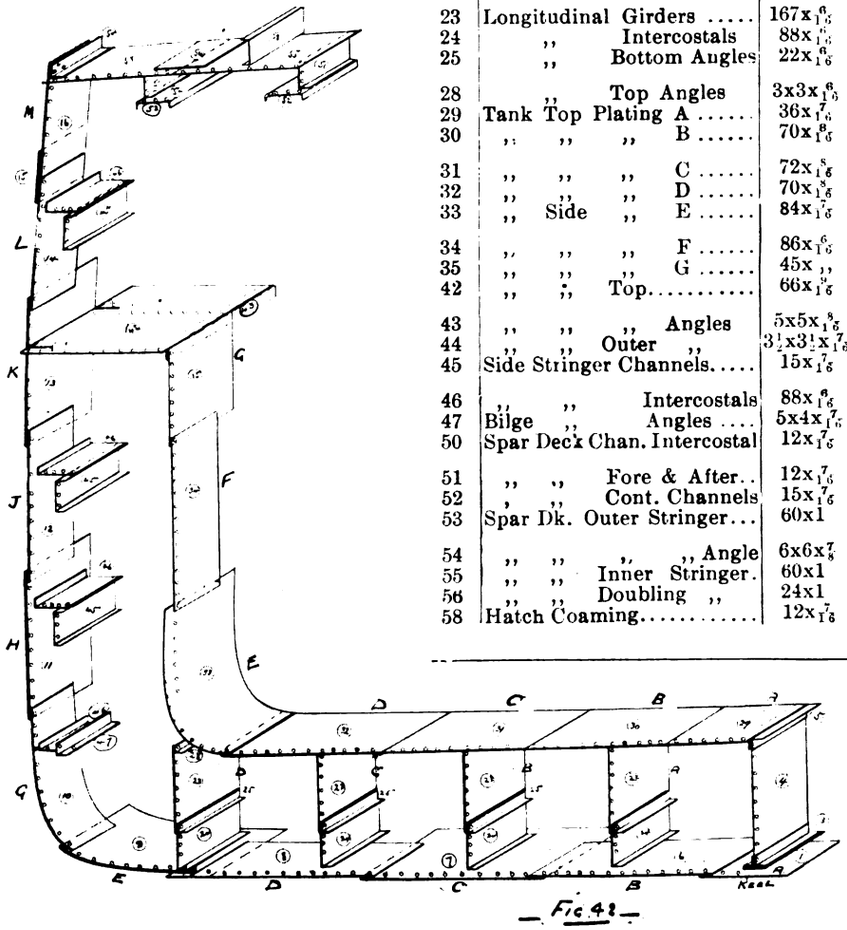
Column 6 shows the diameter of the holes punched or the length of material taken out by punching.

Column 7 shows the sum total of all the holes punched in the parts numbered.

Column 8 shows the reduced material through punching.

Column 9 shows the area of section of the punched material and the unavoidable weakest section of this vessel.

Numbers	Parts	Sizes in Inches	Unpunched Material	No. of Holes	Dia. of Holes	Punched Holes	Sizes of Punched Material	Area of Punched Material
1	Keel Plate	20x$\frac{15}{16}$	18.75	3	$\frac{13}{16}$	3.37	16.63x$\frac{15}{16}$	15.55
3	,, ,, Angles	5x4x$\frac{7}{16}$	6.93	2	$\frac{13}{16}$	2.00	6.25x$\frac{7}{16}$	4.62
4	Center Keelson Plate	60x$\frac{9}{16}$	33 75	9	$\frac{13}{16}$	9.00	51x$\frac{9}{16}$	28.19
5	,, ,, Top Angles	4x4x$\frac{8}{16}$	4.22	2	$\frac{13}{16}$	2.00	3.5x$\frac{8}{16}$	1.80
6	B Strake Shell Plating	84x$\frac{14}{16}$	57.75	13	$\frac{13}{16}$	14.66	69x36x$\frac{8}{16}$	48 00
7	C ,, ,, ,,	84x$\frac{10}{16}$	52.50	12	$\frac{13}{16}$	13.50	70x50x$\frac{10}{16}$	44.00
8	D ,, ,, ,,	,, ,,	52.50	,,	,,	13.50	70.50x$\frac{10}{16}$	44.00
9	E ,, ,, ,,	76x$\frac{12}{16}$	57.00	11	,,	12.50	53.50x$\frac{12}{16}$	40.20
10	G ,, ,, ,,	78x ,,	58.50	11	,,	,,	,,	40.20
11	H ,, ,, ,,	70x$\frac{10}{16}$	43.75	10	,,	11.25	58.75x$\frac{10}{16}$	36.09
12	J ,, ,, ,,	72x ,,	45.00	9	,,	10.12	61.88x$\frac{10}{16}$	38.67
13	K ,, ,, ,,	69x$\frac{11}{16}$	47.43	11	,,	12.50	56.50x$\frac{11}{16}$	38.84
14	L ,, ,, ,,	62x$\frac{15}{16}$	58.12	9	,,	10.12	51 88x$\frac{15}{16}$	48.60
15	,, ,, ,, Strap	24x1	24.00	4	,,	4.50	19.50x1	19.50
16	M ,, ,, Plating	53x$\frac{15}{16}$	49.68	7	,,	7.90	45.10x$\frac{15}{16}$	42.28
23	Longitudinal Girders	167x$\frac{6}{16}$	62.62	28	$\frac{13}{16}$	22.80	144x20x$\frac{6}{16}$	54 08
24	,, Intercostals	88x$\frac{7}{16}$	33.00	16	$\frac{13}{16}$	13.00	65x$\frac{6}{16}$	28.12
25	,, Bottom Angles	22x$\frac{6}{16}$	8 25	8	,,	6.50	15.5x$\frac{6}{16}$	5.81
28	,, Top Angles	3x3x$\frac{6}{16}$	2.06	2	,,	1.60	4.0x$\frac{6}{16}$	1.50
29	Tank Top Plating A	36x$\frac{7}{16}$	18.00	6	1	6.00	30x$\frac{8}{16}$	15 00
30	,, ,, ,, B	70x$\frac{8}{16}$	35.00	11	,,	11.00	59x$\frac{8}{16}$	29 50
31	,, ,, ,, C	72x$\frac{8}{16}$	36.00	12	,,	12.00	60x$\frac{8}{16}$	30.00
32	,, ,, ,, D	70x$\frac{8}{16}$	35.00	12	,,	12.00	60x$\frac{8}{16}$	30.00
33	,, Side ,, E	84x$\frac{7}{16}$	36.75	16	,,	16.00	68x$\frac{7}{16}$	29.75
34	,, ,, ,, F	86x$\frac{6}{16}$	32 25	14	,,	14.00	72x$\frac{6}{16}$	27.00
35	,, ,, ,, G	45x ,,	16.87	8	1	8 00	37x$\frac{6}{16}$	13.87
42	,, ,, Top	66x$\frac{9}{16}$	37.12	11	,,	11.00	55x$\frac{9}{16}$	30.00
43	,, ,, ,, Angles	5x5x$\frac{8}{16}$	4.75	2	,,	2.00	7.5x$\frac{8}{16}$	3.75
44	,, ,, Outer ,,	3½x3½x$\frac{7}{16}$	2.84	2	,,	2.00	4.5x$\frac{7}{16}$	1.96
45	Side Stringer Channels	15x$\frac{7}{16}$	26.25	12	$\frac{13}{16}$	10.75	50.35x$\frac{7}{16}$	22.00
46	,, ,, Intercostals	88x$\frac{6}{16}$	30.00	16	,,	13.00	75x$\frac{6}{16}$	28.12
47	Bilge ,, Angles	5x4x$\frac{7}{16}$	3.72	2	,,	1.60	7x$\frac{7}{16}$	3.05
50	Spar Deck Chan. Intercostal	12x$\frac{7}{16}$	7.00	3	,,	2.40	9.6x$\frac{7}{16}$	4.20
51	,, ,, Fore & After	12x$\frac{7}{16}$	7.00	3	,,	2.40	9.6x$\frac{6}{16}$	4.20
52	,, ,, Cont. Channels	15x$\frac{7}{16}$	17.50	6	,,	4 80	35.2x$\frac{7}{16}$	15.40
53	Spar Dk. Outer Stringer	60x1	60.00	9	$\frac{13}{16}$	10.20	49.8x1	49.80
54	,, ,, ,, ,, Angle	6x6x$\frac{7}{8}$	10.03	2	,,	2.25	9.75x$\frac{7}{8}$	8.52
55	,, ,, Inner Stringer	60x1	60.00	8	,,	9.00	51x1	51.00
56	,, ,, Doubling ,,	24x1	24.00	4	,,	4.50	19.5x1	19.50
58	Hatch Coaming	12x$\frac{7}{16}$	7.00	1	$1\frac{13}{16}$	1.00	15x$\frac{7}{16}$	6.50
			1070.89					913.17



— Fig 42 —

QUESTIONS FOR MASTERS AND MATES.—NO. 14.

205. The equatorial circumference of the earth is 24,902 statute miles; what is the length of a degree of longitude on the equator in statute miles?

206. The polar diameter of the earth is 7,899.5 miles; what is its polar circumference equal to in miles?

207. What will be the weight of 875 cubic inches of water?

208. An immersed body is equal to three quarts of water; what is its volume?

209. A cubic foot of oak will displace how much water? What is the weight of the water?

210. How much of the volume of a cubic foot of cork floating in water is immersed?

211. A hollow iron cylinder 8 in. in diameter with a length of 2 ft. and a weight of 15 lbs. will displace how much of its volume when floated in water? What is the volume of the cylinder?

212. A cubic foot of ice weighs 57.4 lbs.; how much of its volume will be under water when floating?

213. The pressure of the water on the bottom of a tank is equal to the weight of water above it. What is the pressure of the water on the bottom of a cistern whose dimensions are 8 ft. long, 4 ft. width and 3 ft. deep, filled with water?

214. What is the displacement of a floating body weighing 1,000 gross tons?

215. What is the weight of a body having a displacement of 15 tons?

216. A mass of lead having a volume of 2.5 cu. ft. loses how much weight when immersed in water?

217. What will be the weight of 2.5 cu. ft. of lead if a cubic inch of lead weighs 6.56 ounces?

218. A ship, 200 ft. keel length, 35 ft. beam, 15 ft. depth, draws 4 ft. for'ard and 12 ft. aft, or a mean draught of 8 ft. If the ship has square sides and corners, instead of round sides and pointed ends, the volume of that part of the ship immersed would be equal to the cubical contents of a rectangular box having a length equal to the length of the vessel on the water line, a width equal to the beam and a depth equal to the draught of the vessel. Say the round of the bottom and the pointed ends amount to one-third of the volume of the rectangular box; what is the displacement of the ship in gross tons and what is her entire weight in gross tons?

219. How many subic feet of cork will a cubic foot of water buoy up?

ANSWERS TO QUESTIONS FOR MASTERS AND MATES.—NO. 14.

205. 360)24,902(69.17 statute miles. Ans.

206. 7.899.5 × 3.1416 equals 24,817.06 miles.

207. One cu. in. water weighs 0.57 oz. 875 × 0.57 equals 498.75 oz. 16)498.75(31.17 lbs. Ans.

208. 1 pint water contains 28.875 cu. in. Two pints equal 1 quart. 28.875 × 2 × 3 = 173.25 cu. in. Ans.

209. 1 cu. ft. oak weighs 51 lbs. 1 pint water weighs 1.04 lbs. 1.04)51(49.038 pints. 1 pint equals 28.875 cu. in. 49.038 × 28.875 = 1,415.97 cu. in. volume displaced. Weight of water displaced 51 lbs.

210. 1 cu. ft. cork weighs 15 lbs. 15 ÷ 1.04 = 14.423 pints. 14.423 × 28.875 = 416.46 cu. in. displaced.

211. Rule: $D^2 \times 0.7854$ = area. 8 × 8 = 64. 64 × 0.7854 = 50.265. 50.265 area × 24 = 1,206.377 volume of cylinder. 15 ÷ 1.04 = 14.423 pints. 14.423 × 28.875 = 416.46 cu. in. displaced.

212. 57.4 — 1.04 = 55.192 pints. 55.192 × 28.875 = 1,593.66 cu. in. volume immersed.

213. 8 × 4 × 3 = 96 cu. ft. 1 cu. ft. water weighs 62.42 lbs. 62.42 × 96 = 5,992.32 lbs. pressure.

214. 35,887.5 cu. ft. or 1,000 tons (gross).

215. 15 tons if floating, more if not floating.

216. 62.42 × 2.5 = 156.05 lbs. Ans.

217. A cu. ft. lead weighs 709 lbs. 709 × 2.5 = 1,772.5 lbs., or, 1,728 × 2.5 = 4,320 cu. in. 4,320 × 6.56 = 1,771.2 lbs.

218. 200 × 30 × 8 = 56,000 cu. ft. One-third of 56.000 is 18,600 cu. ft. 56,000 — 18,600 = 37,334 cu. ft. 37,344 × 62.42 = 234,038.28 lbs. 234,038.28 ÷ 2,240 = 1,044.81 gross tons. Displacement, 1,044.81 gross tons.

219. 15)62.42(4.16 cu. ft. Ans.

SHIP YARD NOTES.

The Bath Iron Works, Bath, Me., is repairing the Eastern Steamship Co.'s steamship Boothbay, which sunk at her dock last June. Her entire upper works is being rebuilt.

Bertelsen & Peterson, of East Boston, Mass., have been awarded contract by Fire Commissioner Parker, of Boston, for the construction of a fire boat for that city. The vessel is to be of the most modern type and will cost $66,500.

The Heffernan Machine Works, Seattle, Wash., have been awarded contract by the U. S. quartermaster's department, for the repairing of the army transport Dix. The work is to be completed in 10 days at a cost of $3,934.

The Bath Iron Works, Bath, Me., are to launch the turbine steamship Belfast, which has been under construction at that yard for a very long time, so soon as her tail shafts are completed and in position. The ways will then be occupied by the new transfer steamer which that company is to build for the Maine Central railroad.

Lawley & Son, South Boston, Mass., launched a three-masted auxiliary schooner yacht Sept. 15. She was christened Victor II by three sponsors who pelted her bow with flowers instead of wine. The Victor II is 197½ ft. in length over all, 32½ ft. beam and 31 ft. draught. She is to be ready for delivery about Jan. 1.

Oliver Reeder & Sons, Baltimore, Md., have laid the keel for a large open lighter which they are to build for the Empire Coal Co., to be 90 ft. in length, 28 ft. beam and 8 ft. deep.

The New York Ship Building Co., Camden, N. J., has notified the revenue cutter service that it will launch the new cutter Tahoma on Oct. 10 and the Yamacraw on Oct. 24.

James Shewan & Sons, New York City, have had the revenue cutter Androscoggin on their dry dock for a general overhauling. She was sheathed with copper and steel as she is to be stationed at Portland for the winter.

The Pelly Dry Dock Co., Brooklyn, N. Y., have had the British steamer Deramore on the dock, where she received 12 new plates and had about 15 old ones repaired. Her machinery was also overhauled and she received a new shaft and wheel.

The dry dock business at Weehawken, N. J., formerly conducted by Frank Gokey, has recently been reorganized and will now be conducted under the name of the Union Dry Dock & Repair Co. There are two dry docks, one of which is a large one, and they have been put in first-class condition.

A. Kelly has been awarded contract for repairing the British steamer Beechley, which went ashore on the Alaskan coast July 9. She had two holes stove in her bow and many plates were badly wrenched. Mr. Kelly has engaged the Port of Portland dry dock in which to make the repairs to the Beechley, which are expected to take four weeks.

Accidents of a Month.

During the past month over one hundred accidents have occurred to lake vessels, entailing heavy loss to both owners and underwriters. The forest fires in the upper lake regions, which caused a thick smoke to settle over the lakes, were responsible for about one-third of the accidents, some of which were very costly.

Three vessels were totally destroyed, the greatest loss being that of the wooden steamer Neshoto of the Gilchrist fleet which ran ashore on Crisp Point, Lake Superior, in heavy weather, and was pounded to pieces. The other two were the tug Wm. Maxwell, which ran ashore on Thunder Bay Island, Lake Superior, and the steamer Holliday, destroyed by fire at Holland, Mich.

Six collisions occurred between the following vessels: Carferry Pere Marquette No. 3, and steamer Philetus Sawyer, steamers Pleasure and D. G. Whitney, steamers W. G. Pollock and North Star, carferry and a scow, steamer Duncan and barge Paltic, and the schooner Melvin S. Bacon and steamer W. H. Mack. The most disastrous of these was the Pollock-North Star collision, the Pollock receiving twenty damaged plates, and the North Star also sustaining serious injury.

The vessels imperiled by the smoke and fog were on the following: F. H. Goodyear, P. P. Miller, Winnipeg, E. B. Osler, Ball Brothers, Nyack, Arthur Hawgood, W. G. Pollock, North Star, Amazonas, City of Genoa, Henry Phipps, Benton, Sonora, Maxwell, Harvey D. Goulder, Wawatam, J. H. Wade, Langell, F. G. Hartwell, W. P. Palmer, Arthur H. Hawgood, Mary L. Cook, Mohegan, Iron King, A. P. Wright, Arthur Orr, Ionic, Amazon, Frontenac, Thomas Lynch, H. S. Holden and Sawyer.

Heavy repair bills were incurred by the accidents to the Hoover and Mason, W. G. Pollock, W. F. Fitch, Sonora, Frontenac, Lyman C. Smith, Calumet, H. A. Berwind, and barge Baltic.

DATE.	NAME OF VESSEL.	NATURE OF ACCIDENT.	PLACE.
Sept. 6	Str. Hoover & Mason	Became disabled and ran aground; 13 plates damaged, shoe broken and rudder bent; towed to Lorain	Stag Island, St. Clair river.
Sept. 7	Schr. J. L. Green	Struck pier; anchor went through her starboard bow; waterlogged	Harbor Beach, Mich.
Sept. 8	Str. Edward Smith	Wheel became disabled; put back to Buffalo for repairs	Lake Erie, off Buffalo.
Sept. 9	Str. Pere Marquette No. 3	Collided with steamer P. Sawyer	Milwaukee Harbor.
Sept. 9	Str. Philetus Sawyer	Collided with steamer P. M. No. 3; small dent in port side	Milwaukee Harbor.
Sept. 9	Str. J. J. Albright	Struck obstruction; hole punched in bottom	Ft. Gratiot Light, St. Clair river.
Sept. 9	Str. Robt. Wallace	Ran ashore in thick weather; released after lightering about 100 tons	Bois Blanc Island, Straits of Mackinac.
Sept. 10	Str. Pleasure	Hit by steamer D. C. Whitney while lying at dock; repaired at Detroit	Detroit river.
Sept. 10	Str. Myron	Lost her wheel; picked up by tug and towed to Keweenaw Bay	Portage Entry, Lake Superior.
———	Str. A. E. Nettleton	Ran on rock; went to Toledo for repairs	Below Canadian Lock, Sault canal.
Sept. 10	Str. Conestoga	Grounded; released on Sept. 12 uninjured; passengers taken off	Little Traverse Island, Portage Lake.
Sept. 12	Str. F. H. Goodyear	Ran aground in heavy smoke; released, uninjured	Grassy Island, Detroit river.
Sept. 12	Str. P. P. Miller	Ran ashore in heavy smoke; released, uninjured	Lake Michigan.
Sept. 13	Str. Winnipeg	Stranded in thick smoke; released, uninjured, after lightering 250 tons	Straits of Mackinac.
Sept. 13	Str. E. B. Osler	Ran aground in thick smoke; released, uninjured	Bar Point, Detroit river.
Sept. 14	Str. Ball Bros.	Stranded on rock in thick weather; released herself, uninjured	Near Detour, Lake Huron.
Sept. 14	Str. Nyack	Stranded on a sand bar in dense smoke; released, uninjured	Muskegon Lake.
———	Str. O. A. Carpenter	Sprung a leak, repair bill, $500	Manitowoc breakwater.
Sept. 15	Schr. Geo. B. Owen	Sprung a leak while loading; towed out under breakwater and beached; later docked at Cleveland	Cleveland, O.
Sept. 15	Str. Arthur Hawgood	Ran aground in heavy smoke; released after lightering 800 tons, which it reloaded	Bar Point, Detroit river.
Sept. 15	Str. Eastern States	Lost her anchor	Southeast Shoal.
Sept. 16	Str. W. G. Pollock	Collided with steamer North Star in thick smoke; 20 damaged plates; repaired at Cleveland; damage above water line	Point Iroquois.
Sept. 16	Str. North Star	Collided with steamer W. G. Pollock in thick smoke; repaired at Superior	Point Iroquois.
Sept. 16	Str. Amazonas	Grounded in thick weather; released uninjured	Six Mile Point.
Sept. 16	Str. W. F. Fitch	Struck anchor lying in channel; bottom badly damaged; nine plates removed and a number of frames broken; docked at Cleveland	Ashtabula.
Sept. 17	Str. Wm. G. Mather	Struck anchor lying in channel; sank to bottom of river; floated on Sept. 18 and taken to Toledo where she was docked	Ashtabula.
Sept. 17	Str. City of Genoa	Grounded; released, uninjured	Poe's Reef, Lake Huron.
Sept. 17	Str. Henry Phipps	Stranded; released herself; hole in No. 7 tank; docked at Lorain	S. Manitou Island, Lake Michigan.
Sept. 18	Str. Benton	Ran aground in thick fog	Belle Isle, Detroit river.
Sept. 18	Scow	Hit by a car ferry and demolished; scow was used as a mixing scow in connection with Michigan Central tunnel	Detroit river.
Sept. 19	Str. Sonora	Ran on rocks; floated on Sept. 21; docked at Cleveland; 47 damaged plates; three weeks in dry dock	Near Harbor Beach.
Sept. 19	Tug Wm. Maxwell	Ran ashore; total loss	Thunder Bay Island, Lake Huron.
Sept. 19	Schr. Melvin S. Bacon	Hit by steamer W. H. Mack; leaked badly	Cuyahoga river, Cleveland.
Sept. 19	Str. Holliday	Destroyed by fire; cause unknown	Holland, Mich.
Sept. 20	Str. Harvey D. Goulder	Ran aground in thick smoke; released herself, uninjured	Fighting Island, Detroit river.
Sept. 21	Str. Wawatam	Ran on rocky bottom; released; slightly injured	Poe's Reef, Lake Huron.
Sept. 21	Str. J. H. Wade	Struck rock in thick weather; released after lightering part of her cargo	Near Calumet, Lake Superior.
Sept. 21	Bge. Atmosphere	Crushed against Solvay Process Co.'s dock by steamer Republic; beached, pumped out and taken to Port Huron; bow smashed and large hole in side	River Rouge.
Sept. 21	Str. Langell	Ran ashore in dense fog; released after lightering 200,000 ft. of lumber	Point Aux Pins, Lake Erie.
Sept. 21	Bge. Goshawk	Broke away from steamer Zillah and ran aground	St. Clair river, near Sarnia.
Sept. 22	Str. F. G. Hartwell	Ran aground in smoke and fog; released after lightering considerable of her cargo; leaked badly; docked at Toledo	Sea river.
Sept. 22	Str. W. P. Palmer	Ran aground in fog and smoke; released, uninjured	Poverty Island Shoal, Lake Michigan.
Sept. 22	Str. Arthur H. Hawgood	Ran aground in fog; released on Sept. 26 after lightering about 600 tons; not injured	Cat Head Point, Lake Michigan.
Sept. 22	Schr. Mary L. Cook	Ran ashore	Detour Point.
Sept. 23	Str. Mohegan	Stranded in fog and smoke; released after lightering; slightly damaged	Charity Island, Saginaw Bay.
Sept. 24	Tug M. Matthew	Hawser got in her wheel	Amherstburg, Ont.
Sept. 24	Str. Iron King	Grounded in fog; released after lightering	Crecian Shoal, Lake Erie.

DATE.	NAME OF VESSEL.	NATURE OF ACCIDENT.	PLACE.
Sept. 24	Str. A. P. Wright	Grounded in fog; released after lightering	Lake Erie.
Sept. 25	Str. Arthur Orr	Stranded in fog; released after lightering 50,000 bu. of corn; not injured	Packards Point, Straits of Mackinac.
Sept. —	Str. Yosemite	Lost her anchor	Soo river.
Sept. 26	Str. Ionic	Ran aground; released after lightering; bottom slightly damaged	Lake Huron, near North Point.
Sept. 26	Tug Erna	Hit by steamer W. C. Richardson; eight stanchions broken	Waukegan, Ill.
Sept. 26	Str. Topeka	Cylinder head of unloading engine blew out; hold of steamer considerably damaged	Traverse City.
Sept. 26	Schr. Amazon	Grounded in fog and smoke; released after lightering	Buffalo breakwater.
Sept. 27	Frontenac	Ran ashore; released Oct. 2 after lightering 800 tons; leaked badly; temporarily repaired and proceeded to Cleveland	Parisian Island, Whitefish Bay.
Sept. 27	Str. Thomas Lynch	Ran ashore; released herself; uninjured	Soo river.
Sept. 27	Str. H. S. Holden	Grounded; released after lightering 400 tons	Bar Point, Detroit river.
———	Str. Pappoose	Lost her wheel; taken to Detroit for new one	Bois Blanc Island, Detroit river.
———	Str. Sawyer	Grounded; released, uninjured	Niagara river.
Sept. 27	Str. Neshoto	Ran ashore in thick weather; pounded to pieces	Crisp Point, Lake Superior.
Sept. 29	Str. Lyman C. Smith	Struck west pier; hole 3 ft. wide and 20 ft. long in side; sank in 24 ft. of water; floated on Oct. 3 and taken to Sault, where she was temporarily patched up	Canadian canal, Soo.
Sept. 29	Str. Calumet	Stranded; released Oct. 4 after lightering 1,200 tons; several plates broken; work of releasing very difficult	Stag Island, St. Clair river.
Sept. 29	Bge. Montezuma	Struck steel dredge at Limekiln Crossing; not injured	Detroit river.
Sept. 29	Steel dredge	Hit by barge Montezuma; three spud anchors broken; leaked badly	Detroit river.
Sept. 29	Dredge Gladiator	Burned; sank in 15 ft. of water; to be raised	Detroit river.
Sept. 29	Str. City of Buffalo	Broke bucket off her wheel; went back to Buffalo for repairs	Lake Erie.
Sept. 29	Str. Panay	Ran aground; released, uninjured	Bar Point, Detroit river.
Sept. 29	Str. Philip Minch	Lost one of her anchors while loading grain; recovered anchor later	Duluth, Minn.
Sept. 30	Bge. Paisley	Broke away from steamer Honduras which towed her; yawl washed away; picked up by passing steamer in leaking condition	Lake Huron.
Sept. 30	Bge. Baltic	Broke away from steamer Duncan three times while coming from the Straits to Port Huron	Lake Huron.
———	Str. H. B. Hawgood	Grounded; bottom damaged; docked at Cleveland	Sandusky Bay.
Sept. 30	Schr. Major Ferry	Ran on rocks in heavy storm; badly damaged	North Point, Lake Huron.
Sept. 30	Schr. Ida	Capsized in storm; crew rescued	Lake Michigan, near Frankfort.
Oct. 1	Str. W. H. Gilbert	Grounded; released; uninjured	Head of West Neebish.
Oct. 1	Bge. I. L. Bell	Grounded; out 30 in.; released on Oct. 5 after lightering	Head of West Neebish.
Oct. 1	Bge. Ceylon	Broke tow line and ran ashore	Port Colborne, Ont.
Oct. 1	Str. Ralph and consort	Ran ashore	Near Bellevue, Ont.
Oct. 1	Str. John Duncan	Ran ashore; stern damaged; repaired at Detroit	Detroit river.
Oct. 1	Bge. Baltic	In tow of steamer Duncan and ran into her when she stranded; bow smashed; unloaded at Detroit	Detroit river.
Oct. 1	Str. Hankinton	Air pump broke	Lake Huron.
Oct. 1	Bge. Matanzas	Broke away from steamer Rappahannock in storm; not injured	Lake Superior.
Oct. 2	Str. Jos. S. Morrow	Ran aground	Head of West Neebish.
Oct. 2	Str. H. A. Berwind	Struck obstruction; 15 damaged plates	Conneaut Harbor.
———	Bge. Golden Age	Damaged while navigating in heavy weather; arrived at Cleveland in leaking condition; towed to Lorain for repairs	Lake Huron.
Oct. 3	Str. S. C. Hall	Ran ashore; leaked when released, but not badly damaged	Black river reef.
Oct. 3	Bge. Angus Smith	Damaged by fire; loss, $3,000 or $4,000	Bay City, Mich.
———	Schr. Naiad	Picked up in water-logged condition and taken to Port Huron	Lake Huron.
Oct. 4	Str. Ream	Ran aground in heavy fog; released, uninjured	St. Clair river.
Oct. 4	Str. Stewart	Ran aground in heavy fog; released, uninjured	St. Clair river.
Oct. 4	Str. Ohl	Steering cable parted; blocked channel	Dyke, Soo river.
Oct. 4	Str. Briton	Grounded in foggy weather; hole in one of her tanks	Bar Point, Detroit river.
Oct. 4	Str. Price McKinney	Grounded, owing to low water	Buffalo creek.
Oct. 5	Bge. Mowatt	Stranded	Crab Island, Straits of Mackinac.
Oct. 5	Bge. Jenness	Struck north entrance, bound up; temporary repairs necessary before she proceeded	Soo lock.

CHANGE IN HARBOR LINE.

Lieut. Col. Graham D. Fitch of Duluth, has been notified by the department at Washington that a change has been made in the position of the Minnesota point harbor line, by secretary of war, Sept. 21, 1908, in accordance with a recommendation made by Col. Fitch, under date of June 22, last.

This change consists of moving the harbor line 750 ft. in toward the shore, commencing nearly in front of the Duluth Boat Club, and for a distance of about 4,250 ft. along Park point to Nineteenth or Pine street. It is the same position as was concurred in by the citizens of Duluth at a public hearing in Col. Fitch's office on June 20.

The object of this change is to give the additional room for the extension of the anchorage basin which was recommended by the board of engineers which met in Duluth in June, and the dredging for which the last congress made provision. The dredging, as is well known, is now in progress, but has been confined to that part of the basin to the west of the old harbor line while awaiting action of the department regarding the change.

The new harbor line is 990 ft. from the west line of Minnesota avenue, and it adds 69 acres to the public navigable water at the north end of Superior Bay. No change is made in the harbor line southward from Pine street, except to run a diagonal line at about 45 deg. to meet the old line.

AROUND THE GREAT LAKES.

The barge Baltic, which smashed her bow in collision with the steamer Duncan at Bar Point, unloaded her cargo of barley at Detroit.

Col. Wm. H. Bixby, government engineer, with headquarters at Chicago, has been transferred to St. Louis, where he will take charge of river improvements in the Mississippi.

Pumps will be started in a few days to remove the water from the second section of the new Livingstone channel in the lower Detroit river. The contractors have the big cofferdam completed. It has taken all summer to build the cofferdam. As soon as the water is removed, the work of blasting a channel through the rock will begin.

The Reid wrecking tug, Winslow, released the steamers Ream and Stewart, which went aground at Port Huron during a fog on Sunday.

After lightering her deck load of coal, the steamer Stephen C. Hall of the Gilchrist fleet, was released from Black River Reef on Monday.

The eighth section of the Michigan Central tunnel tubes has been safely delivered at Detroit, from the St. Clair yard of the Great Lakes Engineering Works.

The steamer Calumet grounded at the head of Stag Island, St. Clair river, and was released with considerable difficulty. The steamer Queen City and the wrecking tugs Favorite, Harding, Excelsior and Sarnia, pulled on her. About 1,200 tons of her cargo had to be lightered into the Rescue. The Calumet was taken to Cleveland for repairs.

THE CONTRACTOR'S PLANT AND METHODS ON MARE ISLAND DRY DOCK NO. 2.

(From *The Engineering Record.*)

The navy yard at Mare Island, California, has at present a single stone masonry dry dock 400 ft. long and 122 ft. wide, which has long been inadequate to serve modern cruisers and battleships. Over 10 years ago an appropriation for a new dock of adequate size at that time was made by congress, but various circumstances have greatly delayed the construction of this second dock. The original plans for the latter contemplated a timber structure, and a contract for the construction according to these plans was awarded. Before much actual construction had been undertaken under this contract, however, the decision was made to build the dock of concrete instead of timber, the structure to be approximately 130 x 790 ft. in plan at the limits of the masonry. After work had been in progress for some time, according to the revised plans, the contract was abandoned, owing chiefly to the exceedingly hazardous and somewhat unexpected conditions encountered. Following a considerable delay thus involved, the contract was again awarded to the Scofield Construction Co., of Philadelphia, Pa., which company has sufficiently overcome the unusual difficulties presented by the site that the completion of the dock within a year may reasonably be expected.

The Mare Island navy yard is on the right bank of Napa creek, a tidal estuary from San Pablo Bay, which is a part of San Francisco Bay, the navy yard being about 25 miles from the Golden Gate. Napa creek has a channel depth sufficient to accommodate the largest vessels of the navy. The navy yard is on an area of comparatively low, flat ground, some of the buildings, in fact, having been erected partially on reclaimed land. The existing stone masonry dry dock was built in an excavation in a strip of ground that rose just above the high-tide level on the downstream side of the main buildings. The axis of this dock is normal to the channel of Napa creek, the entrance being in a line with a sea wall built to hold the channel along the yard.

The site of the new dock is immediately downstream from the existing one, its long axis making an angle of about 30° with the channel of Napa creek, while the upstream end of the site is close to the shore end of the present dock. Although the latter was built under comparativey favorable circumstances, the conditions prevailing at the site of the new dock are unusually adverse. The existing stone masonry dock was built at a point where shale came to the surface, but this shale, like all the adjacent ground, contained pockets of rotten sandstone, sandy, blue clay and conglomerate. The dock was built directly on an excavation in the shale, piles being used only as necessary in the pockets in the latter.

The land end of the site of the new dock for a distance of 200 ft. toward the off-shore end was underlaid at a depth of 20 to 40 ft. from low-water level with a mixed formation in seams at an angle with the vertical. These seams contain disintegrated sandstone, stiff yellow clay and shale, sandy yellow clay, sandy blue clay, with a few occurrences of cemented gravel, or conglomerate, which is water-bearing and scours very easily. Some pockets of a sandstone that disintegrates almost immediately in water, and resembles quicksand, were also found in the formation. The latter was overlaid with about 12 ft. of peat, that was covered with what is locally termed tule mud. This mud has been deposited from the waters of Napa creek, which, together with all the adjacent tidal waters, are heavily charged with particles of clay of remarkable fineness, that have been brought down the various tributary streams from hydraulic mining operations on the headwaters of these streams. This finely-divided clay moves continuously with every tide, but is rapidly deposited in quiet water, where it forms a perfectly instable stratum that has practically no angle of repose, and little capacity for carrying loads. At the land end of the site the tule mud was covered with spoil from the excavation for the existing dock.

From the termination of the mixed formation, 200 ft. from the land end of the site, to the off-shore end of the latter, the peat was underlaid by blue and yellow clay in irregular inclined strata, the yellow clay in places approaching the hardness of shale, and some of the blue clay containing much sand. Beyond the entrance of the dock site the hard material dips very quickly, and at a point 100 ft. from the end of the site 100-ft. piles could not be driven anywhere near refusal. Added to these adverse soil conditions is the necessity, imposed by the site, of building the dock entirely off shore in water 40 ft. deep at low tide, after the dredgings required had been finished, and with a maximum tide variation of 8 ft., the average difference between tides being about 6 ft.

The dock is to be built entirely on a foundation of round piles, over 12,260 of these piles being required. The sub-grade of the concrete at the entrance to the dock is 37.75 ft. below low-tide level, and 36.75 ft. below that level at the head of the dock. The site was dredged accordingly, so the piles could be cut off at levels that would bring their heads well into the base of the concrete. Before this dredging was done the site was divided into four sections. The section at the off-shore end of the site was then dredged to a depth of 2.5 ft. below the sub-grade of the concrete, as an experiment, to determine the depth required to avoid any additional excavation when the piles had been driven. After the first rows of piles were driven in this section, 4 ft. apart on centers in one direction, and 3 ft. apart in the other, soundings demonstrated that the bottom had risen 1.25 ft. Since for a width of 24 ft. along the longitudinal center line of the dock, and along both sides of the latter, piles had to be spaced 18 in. apart on centers, the conclusion was reached to overdredge 1.5 ft. each succeeding section toward the head of the dock. The average total rise after driving the intermediate piles was only 2 ft., although in the area of greatest penetration, toward the head of the dock, the bottom came up, and in some places above grade.

The original contractor attempted to unwater the site of the dock by constructing an earth-fill and sheet-pile cofferdam of the ordinary type around the off-shore end and a part of the off-shore side. This cofferdam was 50 to 200 ft. from the immediate site of the dock, closing with the main land at one end and with a strip of made ground back of the sea wall at the other end. It consisted of two rows of sheet piles and round piles, with the space between the rows filled with earth. Dredging of the dock site had scarcely been well started after this cofferdam was finished before the latter began to show signs of weakness, and then failed entirely. An attempt was afterward made to build a second cofferdam of the same type, but this one also failed, and the contract was abandoned.

When the construction of the dock was undertaken by the Scofield Construction Co., it was evident, from the soil conditions, that some departure

from usual methods of handling similar work would have to be adopted. The employment of a cofferdam similar to the one outlined by the original contractor would have required the sides of the excavation to be lined closely with sheet piles, with the latter held in place by a bank of good soil, or tied back by means of heavy chains or cables anchored at a sufficient distance to prevent the banks from slumping. Such construction would have been necessary to protect the shop buildings of the navy yard adjacent to the site, since it had been determined that the banks would otherwise fall away continuously, due to the sagging of the soft underlying mud. As a result of the movement of the latter, when not confined, vertical cracks would appear in the surface soil in the vicinity of the site, causing continuous land slides. Such a cofferdam would also necessarily have been built 100 ft. from the off-shore end of the site, where hard material is 80 to 90 ft. below low water, and where its construction would have required an enormous amount of fill to give it sufficient stability.

The type of construction used to avoid such a cofferdam and to overcome the adverse conditions of the site is believed to be entirely unique in its application to a project of this magnitude. Briefly, this construction consists of a row of vertical, tight sheet piling extending entirely around the site, 9 ft. outside the limits of the masonry lines of the dock. This continuous row of sheet piling, 1,960 ft. long, is practically water-tight against a head of nearly 50 ft., that is brought on it at high tide when the water is pumped out of the enclosed space. The piling thus forms an immense open caisson, the sides and ends of which are braced apart by a crib of framed timbers in five horizontal planes. This caisson, including the crib of framed braces, contains approximately 4,000,000 ft. B. M. of lumber.

Following the decision to build the dock in a caisson of this type, the construction work was necessarily divided into several distinct operations. The site had to be dredged from an existing depth of from 20 to 30 ft. below low water to a uniform minimum depth of 40 ft. Then the 12,260 round piles had to be driven and sawed off about 36 ft. below low water. Following that, the crib of framed timbers was built up in the water over the site and lowered accurately into place on the tops of the piles 36 ft. below the low-tide level. The sheet piles forming the sides of the caisson were next driven around the sides and ends of the crib, after which the water in the caisson was lowered by pumping and preparations were being made at the time this description was prepared to start placing concrete in the dock. Although these various sequences of operations were accomplished as noted, the specially difficult soil conditions, the long delays due to circumstances entirely foreign to the work and the extreme magnitude of the various features of the undertaking have rendered their execution exceedingly expensive.

The dredging was done with a suction dredge equipped with a 20-in. centrifugal pump. The suction pipe of this dredge was carried by a ladder frame, which was long enough to drop the cutters to the full required dredged depth. The discharge from the pump was carried through a 20-in. steel pipe to an area some 3,000 ft. down stream. The 12,260 piles which have been driven to provide a foundation for the dock are all Oregon fir and were delivered to the site in sailing schooners. Two floating pile-driver outfits weere rigged especially to drive the piles. Each of these outfits was mounted on a 26 x 73-ft. scow built in connection with the work. As the piles all had to be followed under water, to a depth of 40 ft. or more, each scow was rigged with 42-ft. leads shod with steel plates and arranged so sliding gins 88 ft. long could be operated vertically in them.

These gins consisted of two 12-in. 31.5-lb. I-beams, with one side of the web of each beam bearing against and sliding on the steel plate protection on one side of the leads. On the inside of the web of each beam was riveted vertically a pair of 6-in. 13-lb. channels, placed back to back with the two pairs of channels spaced to form leads of proper width for the guides of a No. 1 Vulcan steam hammer, with which the driver was equipped. An I-beam was also riveted vertically to the rear flange of each of the I-beams sliding in the leads to stiffen the latter beams. These stiffener beams were cross-connected in the rear with box yokes placed vertically to allow the hammer and a follower to clear. A 40-ft. stick of blue gum timber, shod on both ends with heavy cast iron caps, was used as a follower. The steam hammer was lashed to the top of this follower, a block of lignum-vitae being placed between the follower cap and the hammer. The sliding gins were arranged so the follower was always supported horizontally at two points, one near each end. A Lidgerwood hoisting engine, with three drums, one to raise and lower the gins, one to handle the piles and the third for handling the hammer and follower, was placed with a steam boiler on the opposite end of the scow from the leads.

The 12,260 piles were driven in 40 to 50 ft. of water and cut off 36 ft. or more below low tide in a space 148 x 810 ft. in plan, with the result that they are very close together. The maximum longitudinal spacing is, indeed, 4 ft. apart on centers, while the maximum transverse spacing is only 3 ft. apart on centers. Extra rows of piles are placed between the four regular rows on each side of the long axis of the dock, between the eight outer rows under the walls and at other points, so that over much of the bottom the piles are as close together as they could be driven.

The necessity for accurately locating each pile according to this excessively close spacing required the adoption of a special method, in order that the driving could progress without being continuously delayed by the instrument work. Large working drawings of the foundation plan were therefore prepared at a scale of ¼ in. to the foot, showing the exact location of each of the 12,260 piles. This plan was divided into four sections by transverse lines starting at the head of the dock. The center lines of the longitudinal and transverse rows of piles were then drawn, paralleling, of course, the two axes of the dock. The center lines of the longitudinal rows were numbered consecutively in both directions from the longitudinal axis of the dock, starting with the latter as 1 and continuing to 44 for the number of both outsde rows. The transverse rows were numbered consecutively from the land end of the dock to the off-shore end. Any pile could thus be immediately located by giving the numbers of the intersecting center lines of the rows in which it was situated, the corresponding intersections on the two sides of the longitudinal axis being designated by North and South, as North 90-40 and South 90-40.

The numbers of the rows were accurately spaced on 10-in range-boards according to the actual full scale of the work, with black figures 6-in. high on a white ground. These range boards were then placed around the site in a position corresponding to the numbers painted on them. The boards were nailed to firmly driven piles, or

posts, entirely outside the limits of the work. When the location was such that they could not be placed parallel to their respective axis, the numbers were projected and laid off with greatest accuracy. In order that the figures might also be seen at night as well as in the day light, a board painted white was placed 1 ft. below and 4 ft. in front of the range boards to act as a reflector for 16-candlepower incandescent electric lamps spaced about 4 ft. apart.

A special engineer's transit stand was built, in order that the instrument could be utilized to the best advantage in connection with the range boards placed around the site. This stand had four steel-angle legs, attached at the top to a ring on which was mounted a specially-built transit base having four gimbal bearings at the quarter points of the circle. A heavily-weighted iron pendulum was attached to the base of the transit, the point of this pendulum just clearing the floor. The special transit stand was firmly attached to the floor of the pile driver scow, 10 ft. in both directions from the center of the pile-driver hammer. The numbers on the range boards around the site were also offset this same distance to produce the proper relations. A brass plate, with two intersecting perpendicular lines marked on its surface, was attached to the floor under the center of the transit. By means of the lines on this plate and the pendulum on the transit the relative level of the floor of the scow could be determined. When this level was out of the horizontal a truck load of pig iron was moved from place to place on the scow to right it. The transit was covered with a house large enough to provide for the transit man to work easily, a window being placed in each of the four sides of the house.

The pile driver scow was first placed relatively in the position in which it was to work and was then moored by six lines, by means of which its movements and location could be accurately controlled. Three of these lines were at one end and the other three at the opposite end of the scow. One line of each set of three extended on the long axis of the scow to an anchor in front, or in the rear of the latter. Each of the other two lines extended from one corner of the scow, normal to the axis of the latter, to an anchor at the side. The two end lines were each on a spool of the pile-driver hoisting engine, while the four side lines were each on gypsy winches. With this arrangement of the six lines the least movement of the scow desired could be obtained and the scow held accurately in any position.

The location of the next pile to be driven in each case was determined by the numbers on the range boards. The transit man could sight on the number on one side and signal to the man handling the lead and rear mooring lines until the scow was pulled ahead, or back, the proper amount. The side lines could then be used to obtain the exactly correct position, which was determined by the transit man with two sights and two reverses. This method proved perfectly accurate and was used with great rapidity soon after it had been adopted.

The piles for the dock as delivered ranged from 40 to 65 ft. in length. They were driven to various penetrations, depending on the soil encountered, the minimum penetration being about 12 ft. and the maximum 46 ft. During most of the work two 8-hour shifts were used continuously, and for a period of exactly three months an average of 35 piles were driven to each 8-hour shift. The best day's work was 74 piles in 8 hours, but this was offset by days when both drivers were out of commission due to the steel gins being badly twisted by landing on some pile previously driven. This twisting was also caused by the 15-ton load of the gins, hammer, follower and pile escaping from the hoisting engineer, due to the lightness of the hoist installed. The method adopted to determine the location of the piles proved specially advantageous to the remarkably rapid work done under these conditions.

A complete record of the conditions regarding each pile was made at the time the pile was driven. The number of the two intersecting center lines determined the location of the pile, while the length and the diameter of both ends could be measured readily. The variation of the tide, the follower reading, the depth of the point of the pile below tide, the penetration, length of the pile in place, amount to be cut off, number of blows to the last 5 in. of penetration and the total number of blows were measured and recorded as the driving progressed. This work was all done by a government inspector and checked by an engineer for the contractor. The records were preserved in field note books, so that the data regarding each of the 12,260 piles was available for use later.

The piles in the regular longitudinal rows were driven over the entire site first, and then in the intermediate rows toward the center and along the sides. By working the drivers straight along one row of piles in this manner the amount of side shifting was greatly reduced. At the same time, the piles could be sawed off to the proper grade much more readily.

A 26 x 73-ft. saw scow was rigged specially for use in cutting the piles off 40 ft., or more, under water. This scow carried at one end a pair of 70-ft. leads in which a 16 x 16-in. timber spud, 70 ft. long, was operated. A vertical 4-in. shaft mounted in bearings on this spud carried a circular saw at the lower end. Saws of such sizes as could be procured were used, ranging from 40 to 50 in. in diameter. The saw shaft was belt-driven, 3 ft. above the deck of the scow, by a steam engine mounted with its boiler on the scow.

One of the gimbal-hung transits was placed on the scow in the same position as that occupied by the one on each pile-driven scow. The saw scow was also located by means of this transit, and was moored by six lines in exactly the same manner utilized in connection with the pile-driver scow. A level target nailed to the spud was used to determine the position of the saw by means of an instrument on the shore.

Serious difficulties were often encountered in sawing off the piles at the considerable depths, resulting in no less than 50 of the circular saws being broken. The chief trouble in this connection was occasioned by water-logged pieces of piles being encountered by the saws. The original contractors had furnished 7,000 piles which had been in the booms three years, added to which was a delay of six months after some of the piles had been driven before cutting was started. The water-logged pieces would drop in front of the saw, and as the saw scow was kept moving continuously the saw would rise up on these pieces sufficiently to break it, or would be caught so the movement of the scow would break it.

While this method of pursuing the work greatly reduced the possibility of missing piles, a diver was used constantly during the time the sawing was in progress to locate any piles that were missed and to determine whether accurate cut-off levels had been obtained. Wherever a pile was found to have been missed by the diver, the latter attached to it a line carrying a buoy in order to locate it for the saw scow.

A floating wooden platform, 3 ft.

wide and 160 ft. long, was used to assist the diver in determining the piles that were in error. This platform had guides mounted on it, at intervals of 16 ft., in each of which guides a vertical pivoted rod, 12 ft. long, operated through a hole in the platform. Each rod had a wire long enough to reach the bottom attached to its lower end, and to each two adjacent wires was attached horizontally a 16-ft. length of gas pipe. The row of lengths of gas pipe were all hung at the same elevation from the floats, the depth being altered to correspond with the tidal variation, by means of tide gages on the platform. As the platform was moved along, any pile too high would immediately be indicated by the change in the position of the adjacent rod, due to the suspended pipe striking the pile. The resulting accuracy was quite remarkable, as only a single pile was found to be enough too high to interfere with the framed crib of the caisson when it was sunk.

The delay involved in securing the machinery and materials for the saw scow is an indication of the hindrances that have been offered to the work from time to time by agencies entirely foreign to the latter. The machinery and the materials were ready to be delivered the day of the San Francisco disaster, April 18, 1906, but were destroyed in the fire, with the result that duplicates were not obtained until the middle of the following July. In a project of this kind where the work must be handled in a series of operations, one following the other, if one of these operations is delayed the whole work is interrupted accordingly.

Work was started on the crib of the caisson as soon as possible after the piles for the dock had been driven. The crib consists of five horizontal courses of transverse and longitudinal timbers, with the timbers in each course braced apart from those in the adjacent courses by posts, and with the whole structure built as a unit, the same as a framed steel structure. The general features of the construction are shown in accompanying illustrations. The longitudinal rows of timbers are 12 ft. apart on centers and the transverse rows 10 ft., the crib taking bearing on the piles through 2 x 12 x 48-in. blocks under the lower course of longitudinal timbers. The timbers in the bottom course are all 16 x 16-in. in cross section, those in the next two courses, 14 x 14 in. and in the two upper courses 12 x 12 in. The walings along the sheet piling of the caisson are 20 x 24 in. in cross section for the bottom course; 18 x 24 in. for the second course; 15 x 24 in. for the third; 16 x 20 in. for the fourth, and 12 x 12 in. for the top course. The two lower courses are 10 ft. 1 in. apart on centers; the second and third are 9 ft. 1 in.; the third and fourth, 10 ft., and the fourth and fifth, 11 ft. 10 in. The posts between the courses are 8 x 10-in. timbers in all cases.

The two center rows of longitudinal timbers in the bottom course are braced together by a horizontal Howe truss. The first and second courses of transverse timbers are also braced together at every fifth row by a vertical Howe truss. Sway braces extending from the bottom to the top course of the crib are placed at the same intervals as the vertical Howe trusses. The various timbers in the different courses are all spliced to make continuous members, and at all intersections of the horizontal and transverse timbers the posts are bolted to the timbers in both directions. In all cases machined bolts were used. Where the horizontal timbers take bearing against the walings a special cast iron shoe was used to distribute the load on the walings, in order to reduce the fiber stresses and prevent crushing.

The timbers of the crib were framed before being delivered to place in exactly the same manner that is followed in fabricating the members of a steel-frame structure. Since the crib alone contains over 2,600,000 ft., board measure, of lumber, this method was imperatively necessary. A 32 x 120-ft. scow was rigged with a stiff-leg bull-wheel derrick and a swinging 50-in. circular cross-cut saw to cut the timbers to the proper length. This scow was moored adjacent to a 50 x 220-ft. timber-framing wharf, which was erected just outside the remaining portion of the original cofferdam. The timbers were rafted up to the scow, lifted on the latter by the derrick, sawed and dumped back into the water on the wharf side of the scow very rapidly. All of the necessary cutting was done and the holes for the connections were bored on the framing wharf. The splice timbers were also bolted to one of the two members to be spliced. A motor-driven saw was installed on the framing wharf for use in cutting planks and small timbers. After the framing had been done the timbers were dropped into the water again and rafted to the site of the crib. Each timber was marked before it left the framing wharf so its designated position could be determined readily when it arrived at the site.

The first work done in building the crib was to drive a row of clusters of piles along each side of the site. Each of the clusters contained three piles, the clusters being spaced 40 ft. apart and driven so as to come at the ends of transverse rows of timbers. A 16 x 16-in. timber, 24 ft. long and extending 14 ft. below low tide was attached vertically to each pile cluster to act as a guide for the crib. The two parallel rows of guides were thus located so two horizontal courses of the timbers of the crib were always between the ends of the guides during the erection work.

The leads were then removed from the pile-driver scows and a stiff-leg A-frame derrick, with its 40-ft. mast and 80-ft. boom revolved by a bull wheel, was placed on each of the scows. These two derrick scows were utilized throughout the construction of the crib to handle the framed timbers into place from the rafts in which they were delivered at the site.

The first framing done on the crib was to assemble the timbers of the bottom course to about one-third the width of the crib for about two-thirds of the length of the structure. This work was done with both derrick scows working in conjunction. The remainder of the timbers in this part of the first course were then placed and the course carried out to the end; the posts and trusses between this course and the second course were being erected at the same time. The erection of these posts and, in fact, of all the posts in the crib was simplified greatly by bolting one of the splice planks to the horizontal timber and the other to the post, before the latter was erected.

The balance of the crib was built as rapidly as the lumber could be obtained and framed. When the first course was finished it floated well out of the water and was not submerged until the second course was practically placed. As the addition of the third course failed to sink the second one—a condition which had been foreseen—200 tons of pig iron were distributed over the timbers of the third course. When the fourth course was built 400 tons more of pig iron were distributed over it, but on the completion of the top course the fourth one was still at the surface of the water. Finally, after placing a total of 1,800 tons of ballast of various kinds on the crib, the latter was sunk

nearly to position. Some delay was encountered, however, in firmly seating the lower course timbers on the pile heads at the lower end of the cofferdam, due chiefly to silt, which had accumulated to a depth of 3 ft. over the heads of the piles. In two other places the peat had slumped into the dredged area and had to be removed with an orange-peel bucket working through the pockets of the crib, and by a hydraulic jet. After the fourth course was under water a few inches in depth of submergence was gained every 24 hours, with each succeeding extreme low tide. The crib was quite instable when the fourth course became submerged, as it had only the buoyancy of the posts to hold it in equilibrium. For that reason, enough ballast could not be placed on the lower end of the crib to hold it in the mud, as the whole structure had to be kept level on account of the rise and fall of the tide. When the crib came within 1 ft. of the piles enough weight was added to the lower end to force it through the soft silt. There was then only one high spot where a single pile was partly cut off, the stub sticking up 7½ in. too high. When this was removed the crib sank true to grade and accurate as to location. The rows of timbers and the walings were as true and straight as though the crib had been built on land, as may be seen from an accompanying illustration, and all of the walings were plumb one under the other.

The sheet piling forming the sides of the caisson consists of 12 x 12-in. timbers, each pile having a total length of 60 ft. As timbers of that length would have been very expensive and difficult to obtain, 34-ft. and 26-ft. lengths were used, the butt joints between the two timbers of the piles being staggered and caulked with oakum.

The sheet piles were practically all assembled and driven in pairs, thus reducing by nearly half the number of pieces to be handled. The two abutting sides of the piles of a pair were not planed, as this would have cost about $6 per 1,000 ft., and the benefit derived was not considered to compensate the expense involved. Two strings of spun yarn were, however, placed in the joint between the piles of a pair, and the sticks pulled together with clamps and machined bolts, so that even with curved piles as good a joint was obtained as though the timbers had been planed. A tongue and grooved joint was made between the pairs of piles by means of splines spiked to the timbers. A 3 x 12-in. plank was cut into three beveled pieces to make each joint, two pieces being spiked to one pile to form the groove and the third piece to the adjoining pile to form the tongue of the joint. Two strands of spun yarn were placed under each spline to assist in making a watertight joint.

The built-up sheet piles were each 12 x 30 in. in cross section, so the leads, hammers and so forth had to be rigged specially to drive them. The leads were removed from the pile-driver scows and widened so they could be used in driving the sheet piles. These leads were set on skids on the top course of timbers of the crib and were moved on greased ways instead of rollers. The same No. 1 Vulcan steam hammers used on the pile driver scows were also used again in driving the sheet piles. The hammers' guide was extended to fit the wide leads by bolting a cast iron chair to each side of it. A special driving cap was also built for the hammer, a block of lignum vitae being used between this cap and the head of the sheet piles.

The sheet piling was driven around the entire caisson, a total length of 1,960 ft. of sheeted wall 60 ft. high, in 30 working days. Three-quarters of the sheet piles were driven in good blue or yellow clay and the remainder in the harder formations at the head of the dock. The piles in the clay were driven practically to refusal, or approximately 24 blows to the last 6 in. of penetration; in the softest places in this clay the piles were allowed to stick up 3 ft. over night, after which three blows of the hammer were required to start a pile, the succeeding blows each giving a penetration of about ¾ in. until the pile was in the full length. The compression in the bottom was so great that when a pile was driven down to the top waling of the crib the adjoining piles already driven would rise 1 to 2 in. The average penetration in the clay was 12 to 14 ft. The driving through the hard materials at the head of the dock was much more difficult, however, single 12 x 12-in. piles being used in this locality. The average penetration of these piles was 7 to 10 ft., with a minimum of 5 to 6 ft., except in one or two isolated cases where small pockets of disintegrated sandstone or boulders were encountered and a penetration of about 3½ ft. was obtained.

While the sheet piling was being driven a diver was used to inspect each day's work the succeeding morning, any openings below the water line being marked, boarded over and later covered with canvas. There were comparatively few such openings, not more than a dozen in an entire 800-ft. side of the cofferdam. The long walls formed by the sheeting were also in remarkably straight lines, practically none of the piles being deflected in them and the walls being entirely continuous.

After the driving was finished the entire cofferdam was further carefully inspected in order that all openings and cracks might be closed. A patch pile or piles was placed wherever the diver found any indication that the splines had been turned away from the piles, even if the opening was only 1 in. wide at the mud line, since such an opening under the 48-ft. head to be brought against the sides of the cofferdam would have produced dangerous scour. In places the piles went in at the bottom in driving, thus bringing a heavy strain on the inside top waling of the crib which occasionally split the corbles and pulled them away from the transverse sill, but tie rods were sufficient to pull these into shape. In four other places, with a total length of about 90 ft., the piles were deflected outward from the walings at the bottom by striking obstructions. In only one case was this departure abrupt, the pile turning sideways sufficiently to necessitate a patch. At the other places the deflection was in the shape of a bow, the maximum departure in the middle of this bow being about 10 in., although the sheeting was continuous and tight. Where the sheeting had departed in this manner the space between it and the two lower courses of waling timbers was filled out with blocks, which were cut to proper shape on the surface and then placed by a diver. Since from the nature of the bottom it was possible for the piles to deflect only slightly under stress this filling was done carefully in all places where the pile did not touch the waling.

(To be continued.)

The third annual lakes-to-the-gulf deep waterways convention will be held at the Auditorium, Chicago, on Oct. 7, 8 and 9. Elaborate preparations are being made for this event and it is expected that both William H. Taft and William Jennings Bryan will speak at the sessions. The convention will embrace an excursion over the field of work already accomplished between Lake Michigan and Joliet.

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